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Art. I.—*Notice of the Botanical Writings of the late C. S. Rafinesque.*

Constantine S. Rafinesque-Schmaltz, a Sicilian by birth, first arrived in this country in the year 1802, where he remained for three years; and returning from his native land in 1815, continued to reside in the United States until his decease in September last, (1840.) The name of this eccentric, but certainly gifted person, has been connected with the natural history of this country for the last thirty-five years; yet, from the manner of their publication, many of his scattered writings are little known to men of science. It is chiefly as a naturalist that Rafinesque is known, although his attention has by no means been restricted to Natural History; since works on Antiquities, Civil History, Philology, Political Economy, Philosophy, and even a poem of nearly six thousand lines, have proceeded from his pen. Botany, however, was his favorite pursuit, and the subject of a large portion of his writings; and to these we purpose to confine ourselves in the present article. Our task, although necessary, as it appears to us, is not altogether pleasing; for while we would do full justice to an author, who, in his early days, was in some respects greatly in advance of the other writers on the botany of this country, and whose labors have been disregarded or undervalued on account of his peculiarities, we are obliged, at the same time, to protest against all of his later and one of his earlier botanical works.

A few years ago, Mr. Rafinesque published his autobiography, entitled, *A Life of Travels and Researches*, (Philadelphia, 1836;)

a characteristic and interesting pamphlet, which is not at present in our possession. An abridged account of his travels and researches in this country, is also given in the introduction to his *New Flora of North America*, which we extract with slight condensation.

"I came to North America in 1802, and travelled chiefly on foot until 1804, over New Jersey, Pennsylvania, Delaware, Maryland, and Virginia, from the Juniata to the sea shore, and from the Alleghany Mountains beyond Easton to the Potomac beyond Washington and Alexandria.——In 1805 I left America for Europe, where I remained till 1815. On my return to this country in that year, I was shipwrecked on the shores of Connecticut, and lost all my former herbals and collections, both American and European.——I had to begin again my researches and collections, which I pursued ever since with renewed zeal, and always at my own sole expense. I spent 1815 and 1816 in the States of New York, New Jersey, and Pennsylvania chiefly. In 1816 I went to explore as far as Lake Champlain, Vermont, and the Saranac Mountains near the sources of the Hudson River. In 1817 I went to the Matteawan or Catskill Mountains, and explored Long Island, where I dwelt awhile. But my great travels in the West began in 1818; I made a tour of 2000 miles, as far as the Wabash River, crossing twice the Alleghany Mountains on foot, and exploring Ohio, Indiana, Illinois, Kentucky, &c.——Having been appointed Professor of Natural Sciences in the University of Lexington, in Kentucky, I went there in 1819, crossing a third time the Alleghany Mountains, through the Cumberland road of Maryland, still on foot, as I never would cross these beautiful mountains in any other way, in order to botanize all the while, and I was rewarded by many new plants. I spent seven years in Kentucky, exploring that State thoroughly, and making excursions to Ohio, &c.: my longest journeys were in 1823, when I went west as far as the rivers Cumberland and Tennessee near their mouths, and next east to the falls of the Cumberland River, and the Wasioto or Cumberland Mountains. In 1825 I undertook a long journey through Ohio and Virginia, crossing the Alleghany Mountains of Virginia, and returning by the Alleghanies of Pennsylvania, always on foot. Next year, 1826, I left Kentucky and settled in Philadelphia; but took a very long botanical journey in the way, going through Ohio to Sandusky on Lake Erie; thence to Buffalo, Niagara, Canada, the New York Canal, &c."

His excursions from 1827 to 1830, were confined to Pennsylvania, New Jersey, New York, Massachusetts, &c.

"Several botanical excursions and journeys were undertaken in 1831, in Delaware, New Jersey, and the Taconick Mountains. While in 1832

I visited Maryland twice; the second time I explored the Cotocton Mountains of Maryland, and the Alleghany Mountains as far as Sherman Valley and the Juniata, quite at leisure, residing sometimes at the top of the mountains. In the year 1833 I proposed to visit the Apalachian Mountains as far as Alabama, but was prevented by an accident and heavy rains. I only went as far as those of Virginia, and again in the Cotocton Mountains. In a second journey I undertook to visit the sources of the Delaware and Susquehannah.——The year 1834 saw me twice in the Alleghany Mountains of the North, once by following the course of the Delaware, the second time westward by the Welsh Mountains, Conewago Mountains, Albany Mountains, Locust Mountains, to the Pottsville mines and sources of the Schuylkill River, returning by Mauchchunk and Allentown. My travels of 1835 were in the central Alleghanies, up the rivers Juniata and Susquehannah, exploring the mountains of Peters, Buffalo, Wisconisco, Mahantango, Tuscarora, Jack, Seven-mountains, &c., with their valleys.——Since then I have chiefly explored South New Jersey and the pine barrens."

He draws a lively picture of the discomforts, as well as the enjoyments of a travelling naturalist.

"During so many years of active and arduous explorations, I have met of course all kinds of adventures, fares and treatment. I have been welcomed under the hospitable roof of friends of knowledge and enterprise, else laughed at as a mad botanist by scornful ignorance.——Such a life of travels and exertions has its pleasures and its pains, its sudden delights and deep joys mixed with dangers, trials, difficulties and troubles. No one could better paint them than myself, who has experienced them all. Let the practical botanist, who wishes like myself to be a pioneer of science, and to increase the knowledge of plants, be fully prepared to meet dangers of all sorts in the wild groves and mountains of America. The mere fatigue of a pedestrian journey is nothing compared to the gloom of solitary forests, when not a human being is met for many miles, and if met he may be mistrusted; when the food and collections must be carried in your pocket or knapsack from day to day; when the fare is not only scanty but sometimes worse; when you must live on corn bread and salt pork, be burned and steamed by a hot sun at noon, or drenched by rain, even with an umbrella in hand, as I always had. Musquitoes and flies will often annoy you or suck your blood if you stop or leave a hurried step. Gnats dance before the eyes, and often fall in unless you shut them; insects creep on you and into your ears. Ants crawl on you whenever you rest on the ground; wasps will assail you like furies if you touch their nests. But ticks, the worst of all, are unavoidable whenever you go among bushes, and stick to you in crowds, filling your skin with pimples and sores. Spiders, gallineps, horse-flies, and other obnoxious

insects, will often beset you, or sorely hurt you. Hateful snakes are met, and if poisonous are very dangerous; some do not warn you off like the Rattle-snakes. You meet rough or muddy roads to vex you, and blind paths to perplex you, rocks, mountains and steep ascents. You may often lose your way, and must always have a compass with you as I had. You may be lamed in climbing rocks for plants, or break your limbs by a fall. You must cross and wade through brooks, creeks, rivers and swamps. In deep fords or in swift streams you may lose your footing and be drowned. You may be overtaken by a storm; the trees fall around you, the thunder roars and strikes before you. The winds may annoy you; the fire of heaven or of men sets fire to the grass or forest, and you may be surrounded by it unless you fly for your life."*

Now for the other side of the picture.

"The pleasures of a botanical exploration fully compensate for these miseries and dangers; else no one would be a travelling botanist, nor spend his time and money in vain. Many fair days and fair roads are met with, a clear sky or a bracing breeze inspires delight and ease, you breathe the pure air of the country, every rill and brook offers a draught of limpid fluid. What delight to meet with a spring, after a thirsty walk, or a bowl of cool milk out of the dairy! What sound sleep at night after a long day's walk; what soothing naps at noon under a shaded tree near a purling brook. Every step taken into the fields, groves and hills, appears to afford new enjoyments. Landscapes and plants jointly meet in your sight. Here is an old acquaintance seen again; there a novelty, a rare plant, perhaps a new one, greets your view; you hasten to pluck it, examine it, admire, and put it in your book. Then you walk on thinking what it might be, or may be made by you hereafter. You feel an exultation, you are a conqueror, you have made a conquest over Nature, you are going to add a new object or a page to science.——To these botanical pleasures may be added the anticipation of the future names, places, uses, history, &c. of the plants you discover. For the winter, or season of rest, are reserved the sedentary pleasures of comparing, studying, naming, describing, and publishing."†

The following list comprises, we believe, all the botanical writings of Mr. Rafinesque which appeared previous to his return to this country in 1815. Those which relate to American botany have reference to his discoveries between 1802 and 1805.

1. Prospectus of Mr. Rafinesque Schmaltz's two intended works on North American Botany; the first on the new genera and species of plants discovered by himself; and the second on

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* *New Flora of North America, Part I, Introduction, p.* 11, *et seq.*

† *New Flora, l. c., Part I, p.* 14.

the natural history of the Funguses or Mushroom tribe of America.—Published in the *Medical Repository*, New York, (edited by Dr. Mitchill,) 2d hexade, vol. 2, 1808.

2. Essential generic and specific characters of some new genuses and species of plants observed in the United States of America, in 1803 and 1804. In a communication to Dr. Mitchill, dated Palermo, Sept. 1st, 1807.—Published in the same work and volume.

3. Notice on the medical properties of some North American plants.—Published in the same work and volume, p. 423.

4. Enumeration of the species of *Callitriche*, and the American species of *Potamogeton*.—Published in the same work, A. D. 1811.

5. An essay on the Exotic Plants which have been naturalized and now grow spontaneously in the middle region of the United States.—Published in the work and volume last cited.

6. Caratteri di alcuni nuovi generi e nuove specie di animali e piante della Sicilia, &c. Palermo, 1810. 8vo., 20 plates.

7. Précis de decouvertes et travaux somiologiques de Mr. C. S. Rafinesque-Schmaltz, entre 1800 and 1814, &c. Palermo, 1814. —A small pamphlet, 24mo. pp. 55.

8. Principes Fondamentaux de Somiologie, ou les loix de la nomenclature et de la classification des corps organisés. Palermo, 1814.—An 8vo. pamphlet of 50 pages.

9. Chloris Etnensis, o le quattro Florule del M. Etna. In the Natural History of Mt. Etna by Recupero. Catania, 1814.

10. Specchio delli Scienze Enciclopedico di Sicilia. Palermo, 1814.—A periodical, of which two volumes were published. The following botanical articles are stated to be published in the work, (which we have not seen,) viz:—Plan of the natural method of Somiology; Description of 20 new genera of plants; of 15 new species of Sicilian plants; of a new genus of *Conferva;* three new genera of marine plants; and a new genus of *Fungi.*

We do not include the following tracts, which Rafinesque has enumerated among his works, since they have never been published, viz:—*Florula Delawarica*, a Catalogue of plants found in Delaware; and *Florula Columbica*, or a Catalogue of plants found in the District of Columbia; both sent in 1804 to the *Medical and Physical Journal*, edited by Prof. Barton. A Monography of the genus *Bertolonia*, sent to the Linnæan Society

of London in 1810; and Monography of the genus *Callitriche*, increased to sixteen species, sent in 1812 to the Linnæan Society.

The two first named articles comprise nearly all that Rafinesque published on North American botany previous to 1815, and consequently anterior to Pursh; and justice to the author perhaps requires that they should be noticed somewhat in detail. He states that his first proposed work, to be entitled *Nova Genera et Species Plantarum Boreali-Americanum*, will comprise, in addition to all the new genera and species discovered since the time of Linnæus, the ten new genera which are indicated in the annexed essay, [No. 2,] and fourteen more which he mentions as follows. [The remarks in brackets are of course our own.]

"*Geanthia* (*colchicoides*,) differs from *Colchicum* merely in the number of the stamens, which are only three in Pennsylvania." [There is little risk in asserting that no such plant exists in the United States. The name again occurs in the list of twenty new genera published in the *Specchio delle Scienze*, &c., which we have not seen.]

"*Micrampelis* (*echinata*,) differs from *Momordica* in the fruit, which is inflated, muricated, 2-3 locular, 2-3 spermous; in Pennsylvania." [We have in vain searched the subsequent works of Rafinesque for any farther notice of this genus. Perhaps the *Echinocystis*, Torr. & Gr. was intended, but the fruit of that plant has four seeds, two in each cell.]

"*Phemeranthus* (*teretifolius*) is very similar to *Talinum*, and is known by some botanists under the name of *Talinum teretifolium*. Penn. and Carol."

"*Merasperma* (*dichotoma*, *bifurcata*, *cylindral.*, *&c.*) belongs to the tribe of *Conferva*, is tubular, inarticulated, with the seeds adhering to the interior of the tubes. Pennsylvania, &c." [He elsewhere calls this genus *Mesasperma*.]

"*Heterodon* (*bryoides*,) small moss with peristome eight dentated, dentatures unequal. It grows in the waters of New Jersey."

"*Leptuberia* (*amorpha*,) small crustaceous lichen. Penn."

"*Heptaria* (*erecta*, *cuneata*, *&c.*,) very like to the *Tremella*."

"*Catenaria* (*arenaria*, *vagabunda*, *concatenata*, *&c.*,) intermediary between some *Confervæ* and *Fuci*. On the sea shores."

"*Atheropogon* (*apludoides*,) genus of *gramens*, near akin to the *Apludo*. I found it in Pennsylvania; the name is of Willdenow in MSS."

"*Leptopyrum* (*tenellum,*) it belongs to the tribe of *gramens*, and is akin to the Avena. Found in Virginia." [We have met with no subsequent notice of this genus.]

"*Florkea* (*palustris,*) was discovered by Messrs. Marshall and Muhlenberg, in Pennsylvania, and named by Willdenow. Hexandria, Digynia: natural order doubtful."

"*Forrestia* (*thyroides,*) near akin to *Ceanothus*, but tri-gynous; was found by Mr. Forrest in the northern part of the State of New York." [From a brief communication in an earlier volume of the Medical Repository, the third of the same series, 1806, p. 422, which escaped our notice in making the above cited enumeration, the locality of this plant, (Ballston Spring,) and a good description are given, which leaves no doubt that this new genus, the earliest of the long series published by this author, is founded upon *Ceanothus Americanus.*]

"*Hexorima* (*dichotoma,*) is very near to *Uvularia* and *Streptopus;* was found by Mr. Marshall, in the Alleghany Mountains of Pennsylvania." [The close alliance of this genus to *Streptopus* may be inferred from the subsequent reference of *S. roseus* to the same genus. Vid. *Journal de Physique*, 1819, 8. *p.* 262.]

"*Gaissenia* (*verna,*) akin to *Trollius;* was communicated to me by Drs. Muhlenberg and Gaissenheimer, who named it *T. Americanus.* It is found in Pennsylvania."

Then follows a list of genera, which he proposes to establish upon known species. This we introduce entire, on account of the evidence it affords of Mr. Rafinesque's sagacity at that early period. Several of these proposed genera had indeed been long established, two of them even by Linnæus himself; but we have no reason to suppose that Rafinesque was aware of their publication.

"*Adlumia* (*cirrhosa,*) which is the Fumaria fungosa, *Ait.*

Cucularia (bulbosa,) is Fumaria Cucullaria, *Linn.*

Calistachya (alba,) is the Veronica Virginica, *Linn.*

Diarina (festucoides,) from the Festuca diandra, *Michx.*

Kampmania (fraxinifolia,) Zanthoxylum tricarpum, *Michx.*

Negundium (fraxinifolium,) Acer Negundo, *Linn.*

Jacksonia (trifoliata,) Cleome dodecandra, *Linn.*

Cuttera [misprint for *Cutlera,*] (saponaria and ochroleuca,) Gentiana, *Willd.*

Denckea (crinita,) Gentiana crinita, ***Willd.***

Persea (macrocarpa,) Laurus persea, ***Linn.***

Heteryta (polemonioides,) Polemonium dubium, ***Linn.***

Scoria [doubtless misprint for ***Hicoria***,] (tomentosa, mucronata, alba, pyriformis, globosa, &c.,) the Hickory.

Vleckia (nepetoides,) the Hyssopus nepetoides, ***Linn.***

Chryza (borealis,) Helleborus trifolius, ***Linn.***

Platonia (nudiflora,) Verbena nudiflora, ***Linn.***, [misprint for *nodiflora*.]

Turpinia (pubescens and glabra,) Rhus aromaticum and suaveolens, ***Willd.*** and ***Michx.***

Umsema [misprint for ***Unisema***,] (obtusifolia and mucronata,) Pontederia cordata, ***Linn.***

Macrotrys (actæoides,) Actæa racemosa, ***Linn.***

Spathyema (fœtida,) Dracontium fœtidum, ***Linn.***

Caullinia (hippuroides,) Hippuris Europæus, *r.* ***Michx.***

Achroanthes (unifolia,) Malaxis unifolia, ***Michx.***

Kraunhia (frutescens,) Glycine frutescens, ***Linn.***

Savia (volubilis,) Glycine monoica, ***Linn.***

Apios (tuberosus,) Glycine apios, ***Linn.***

Triadenium (purpurascens,) Hypericum Virginicum, ***Linn.***

Hingstonia (exaltata,) Siegesbeckia occidentalis, ***Linn.***

Gonotheca (helianthoides,) Polymnia Tetragonotheca, ***Linn.***

Trachysperma (natans,) Menyanthes trachysperma, ***Michx.***"

Nearly all the genera of this list, with the exception of those formed from Gentiana, are admitted by botanists, although mostly under different names.* In the next paragraph, Rafinesque

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* Adlumia, adopted by De Candolle, is doubtless a good genus. Cucularia had been long anticipated by Borkhausen, under the name of *Dielytra* or *Dicentra*. Calistachya, *Ruf* is of later date than *Callistachys* of Ventenat; Leptandra, *Nutt.* is the next in order of publication, but the genus is not considered a good one. Dianina is adopted with a change in the orthography. Kampmania is typical *Zanthoxylum*, that genus having been founded upon the Southern species, as a distinguished botanist has recently informed us. Negundium, or Negundo, was proposed by Mœnch. Jacksonia, Rafinesque changed in 1819 to *Polanisia*, probably on account of the Jacksonia of Brown, 1812, by which General Jackson has lost a genus. The genera founded upon Gentiana, are of no account. Persea was founded by Gærtner. Heteryta is a *Phacelia*. Hicoria, or Hicorius, was ten years later called Carya by Nuttall. Vleckia is the recent *Lophanthus* of Bentham. Chrysa is the *Coptis* of Salisbury. Platonia, (which Rafinesque afterwards changed to *Bertolonia*,) = *Zapania* of Jussieu, &c. = Lippia, *Linn.* Turpinia forms a good genus or section; but the name being pre-occupied, the author changed it to *Lobadium*, and Desvaux to *Schmalzia*. Unisema may be well distinguished from the other species

proposes to rëestablish the genus *Sarotha* "and to compose it of all the *Hypericums*, which have few stamens and an unilocular capsule, ... and to divide the genus *Monotropa* into two, re-establishing the old genus *Hypopythis;* and *both shall form a separate natural order or tribe*, under the name of *Monotropeous.*" Here we have the order or sub-order Monotropeæ, indicated ten years before its publication by Nuttall. In a short list of some species to be distinguished from allied ones of Europe, he proposes *Erythronium angustatum*, for the *E. Dens-canis* of early American authors; *Trientalis borealis*, for *T. Europæus*, of the same; *Lysimachia capitellata*, for *L. thyrsiflora*, Michx.; and *Viburnum edulum* for *V. opulus*, Michx.; in which cases, except perhaps the first, he has anticipated other botanists. In other instances he has made mistakes; he proposed *V. lentagoides* for the American *V. Lentago*, forgetting that Linnæus established the species on an exclusively American plant; and his *Asclepias fragrans* for the American *A. Syriaca* is in the same predicament. The second part of the essay is occupied with *Fungi*, and several new genera are proposed; upon which we have no observations to offer.

Ten new genera are proposed and characterized in the second essay, which follows the former. 1. *Phyllepidium* (*squarrosum*,) said to be an Amaranthaceous plant, found near Baltimore; we do not recognize it.—2. *Schultzia* (*obolarioides*,) said to be "very near akin to *Obolaria*," is undoubtedly the plant itself.—3. *Burshia* (*humilis*,) which is *Myriophyllum ambiguum.* The genus is dedicated to Pursh, but the orthography is incorrect.—4. *Diphryllum* (*bifolium*,) is the same as *Listera*, of Brown, and much older; but in a later memoir the author insists that it is

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of *Pontederia*, but it is the original species of that genus. Macrotys (here written *Macrotrys*,) which afterwards Rafinesque changed, without reason, to *Botrophis*, although still adopted by some good botanists, is too near *Cimicifuga.* Spathyema= *Symplocarpus*, of Salisbury. Achroanthes is long anterior to Nuttall's *Microstylis.* Kraunhia is also anterior to *Wistaria*, or *Thyrsanthus;* but Rafinesque seems ever after to have overlooked the name; and in the *Journal de Physique*, he states that he had called it *Savia*, forgetting, probably, that his Savia (posterior to Willdenow's) is the same with Elliott's *Amphicarpæa.* Apios forms the third instance, in this list, in which Rafinesque has proposed new genera upon the same plants and under the same names as Mœnch had done fourteen years before! Triadenium= *Elodea* of Adanson. Hingstonia=*Verbesina*, Linn. Gonotheca=*Tetragonotheca*, Linn. Trachysperma=*Limnanthemum*, Gmel. 1769.

different from Listera.—5. *Isotria*, and 6. *Odonectis*, are apparently both founded upon *Pogonia verticillata*.—7. *Carpanthus* (*axillaris*,) is said to be a submersed fern, growing in Pennsylvania and New Jersey.—The three remaining genera belong to *Fungi*. Sixty new species are also described, many of which may be identified, and should not be overlooked.—The few notes on the properties of some North American plants, [No. 3,] contain nothing worthy of particular notice.

The plants described in the *Précis des découvertes*, are chiefly Sicilian: there are, however, several new American genera and species of *Algæ* and *Fungi*, and one new phanerogamous genus, viz. *Tussaca*, which is the *Goodyera* of Brown; the latter published, not in the same year with his own, as Rafinesque elsewhere states, but one year previous, viz. in 1813. We have never seen the *Specchio delle Scienze;* but learn from a list given by Rafinesque in an advertisement, that several of the new genera of plants it contains, are republished from the Medical Repository: but here *Psycanthus* and *Triclisperma* first appear, (both founded on *Polygala*, the latter equivalent to *Chamæbuxus*;) also *Crafordia*, which is still a puzzle, and *Bivonea*, which is founded on *Jatropha stimulosa*. The remainder, so far as they are noticed by succeeding botanists, are referred as synonyms to different exotic genera; but of several we find no subsequent mention, either by Rafinesque or others. Among these are *Kinia* and *Wilsonia*, which, being doubtless dedicated, the one to a German collector in this country, who corresponded with Muhlenberg, and the other to the well known ornithologist, were probably founded on plants of the United States.

We have thus noticed, somewhat in detail, the earlier labors of Mr. Rafinesque, in North American botany.* In these, he had certainly shown no little sagacity; and, considering his limited advantages, he must be deemed a botanist of unusual promise for that period, notwithstanding the defects which, increasing in after life, have obscured his real merits, and caused even his early wri-

* As early as 1808, Rafinesque had commenced the practice, (not uncommon at that day) of changing generic names when they were not conformable to the Linnæan canons, or even when they were too long or too short. Thus *Calinux* was proposed for Pyrularia, *Michx.* (*Hamiltonia*, Willd.,) *Lyonia* for Polygonella, *Michx.*, *Osmodium* for Onosmodium, *Michx.* &c.—Most of the new genera, &c., published in the Medical Repository, were republished by Desvaux, in his *Journal of Botany, vol.* 2, 1809.

tings to be in a great measure disregarded. The botany of the United States offered, at that time, a fine field to a botanist acquainted with natural affinities; and Rafinesque was the only person in this country, who had any pretensions to that kind of knowledge. All we can justly say is, that he possessed talents which, properly applied, would have raised him to a high rank in the science, and that he early apprehended the advantages of the natural classification, although he was by no means well grounded in structural and systematic botany. As early as 1814, indeed, he sketched a general classification of organized beings, to which he continued to attach great importance; but there is nothing new in it except the names, the botanical portion being merely an anagram of Jussieu's leading divisions. His fuller developments of this system certainly contain much that is novel, but at the same time very absurd.*

Rafinesque's botanical writings between 1815 and 1818, (from his return to the United States, until the publication of Nuttall's *Genera of North American Plants,*) consist of some reviews of the works of Pursh, Eaton, Bigelow, &c. (some of which appeared early in 1818,) communicated to the *American Monthly Magazine;* one or two small papers describing plants or animals in the same magazine; and the *Florula Ludoviciana,*† upon which we feel compelled to make some animadversions. The history of this singular production is briefly this.

A Mr. Robin, who traveled in Louisiana soon after the commencement of the present century, appended to his book of travels‡ a popular account of the plants he had observed, under the

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* Vide *Flora Telluriana*, 1836, *part* 1*st*, *p.* 26, *et seq.* We have not seen the "*Analysis of Nature*, 1815," from which the "Table of New Natural Families," a curious mass of nonsense, is said to be substantially taken.

† *Florula Ludoviciana; or a Flora of the State of Louisiana; translated, revised, and improved from the French of C. C. Robin.* By C. S. Rafinesque, &c. &c. New York, 1817, 12mo. pp. 178, (including the supplement.)—Perhaps we should also include among the published works of this period, a "*Florula Missurica, Mandanensis et Oregonensis*," as a pamphlet under this name is mentioned in a "Chronological Index of the principal Botanical works and discoveries published by C. S. Rafinesque," (Herbarium Rafinesquianum, second part;) but this index comprises several works which we elsewhere learn have never been published, and we suspect the above mentioned work is in the same condition.

‡ *Voyages dans l'interieur de la Louisiane, de la Floride Occidentale, et dans les iles de la Martinique, et de Saint Domingue, pendant les années* 1802—1806, &c. &c.—Paris, 1807, 3 vols. 8vo.

title of *Flore Louisiane.* This account, as Robin informs us, was prepared from notes made on the living plants, and it is evident (although there is no direct statement on the subject,) that he brought no collection of specimens to Europe, excepting a few seeds for the *Jardin des Plantes.* It is written in French; and the characters of the orders and genera are translated from Jussieu, which gives the work an appearance of scientific precision much beyond its just pretensions. Its value of course depends altogether upon Robin's botanical knowledge and his success in referring the plants he notices to their proper orders and genera; and we remark that the work itself affords no evidence of his competency to the task. Indeed, on Rafinesque's own showing, we can place little confidence in Robin's determinations; for, according to the former, he mistook the leaf of a *Sarracenia* for the spathe of an *Arum*, and described a species of *Podophyllum* as a second species of Arum; he took two species of something near *Commelina* for Orchideous plants; described a *Celtis* as an unknown Proteaceous plant, a plant of the Cherry tribe for a true Laurel, a new genus (?) of *Ranunculaceæ* for a Polygonaceous plant, and the common *Ceanothus* for *Polygonum frutescens;* he mistook *Amsonia* and *Dichondra* for species of *Menyanthes*, a new genus (?) of *Scrophularineæ* for a *Polygala*, a *Phlox* for a *Manulea*, a *Justicia* for an *Amethystea*, an *Hydrolea* for an *Apocynum*, a new genus (?) intermediate between *Oxycoccus* and *Vaccinium* for a *Campanula*, and a species of *Eryngium* for a thistle. On the sole authority of the descriptions and determinations of such a botanist, Rafinesque has established thirty new genera and one hundred and ninety-six new species; and professes to reduce all his plants to their proper orders and genera, correcting Robin's mistakes by his own descriptions. It is worth noticing that a large portion of the one hundred and four plants which are referred to old species, are merely enumerated, and scarcely if at all described by Robin; but in almost every instance in which Robin has given a somewhat detailed description, Rafinesque has not been able to recognize the plant, but has considered it a new genus or species. From this fact, one may form a good idea of the value of Robin's account, and of Rafinesque's new genera and species. We do not pretend to say that Robin really made the blunders which Rafinesque charges upon him, (of which the specimens we have given are only some of the most striking;)

for upon the whole, we place quite as much confidence in his determinations as in Rafinesque's corrections. But we do say, that there is no reason for supposing that Robin has been more successful in the instances which Rafinesque has adopted, and upon which his new species of existing genera rest; and we confidently state, that it is impossible, with all the knowledge we now possess of the botany of that region, to recognize one species out of fifty, with tolerable satisfaction, from Robin's descriptions, which must nevertheless have been drawn from the more common plants of Louisiania; and we never heard of the re-discovery of any one of these new genera and species, although many intelligent botanists and diligent collectors reside in, or have since visited that region. The *Flore Louisiane*, in the state Robin left it, could do no harm, and whatever information it contained was quite as available as at present. As *improved* by a botanist who had never been within a thousand miles of Louisiana, and who at that period, could scarcely have seen a dozen Louisianian plants, the only result has been to burthen our botany with a list of nearly two hundred *species semper incognitæ*. There can, we think, be but one opinion as to the consideration which is due to these new genera and species: they must be regarded as fictitious, and unworthy of the slightest notice.*

As the works of Nuttall, Elliott, Barton, and others appeared, Mr. Rafinesque published critical notices of them in the American Monthly Magazine. He soon after collected and condensed these criticisms, and republished them, with some additions, in the *Journal de Physique* for 1819, with the title of *Remarques critiques et synonomiques sur les Ouvrages de MM. Pursh, Nuttall, Elliott*, etc. In these many suggestions of more or less impor-

* We are constrained, by the length to which this article has extended, to omit a series of extracts we had prepared in fuller confirmation of our remarks.—We are bound to mention the excuse Rafinesque offers for this production. In the *Herbarium Rafinesquianum*, p. 17, he says: "I have been reproached wrongly to have published my Florula Louisiana out of Robin, without specimens; but Gronovius did so with Clayton, and Willdenow with Loureiro. Robin's herbarium may be seen in France as well as Michaux's," *etc.*—The case of Loureiro's Flora Cochin-Chinensis may perhaps be something to the purpose; but every botanist knows, or may easily know, that the assertion is altogether untrue as regards the *Flora Virginica* of Gronovius, who had the specimens as well as the notes of Clayton in his possession. We find no evidence that Robin brought back a single dried specimen to France: he professes to have drawn his descriptions from the living plants.

tance are thrown out, new genera are proposed, and many genera and species reclaimed on the ground of priority in publication. It is indeed a subject of regret, that the courtesy which prevails among the botanists of the present day, (who are careful to adopt the names proposed by those who even suggest a new genus,) was not more usual with us some twenty years ago. Many of Rafinesque's names should have been adopted; some as matter of courtesy, and others in accordance with strict rule. But it must be remembered, that the rule of priority in publication was not then universally recognized among botanists, at least as in present practice, (the prevalence of which is chiefly to be ascribed to the influence of De Candolle;) the older name being preferred *cæteris paribus*, but not otherwise. It is also true, that many of the scattered papers of Rafinesque were overlooked by those who would have been fully disposed to do justice to his labors, had they been acquainted with them; and a large portion of the genera proposed in his reviews of *Pursh*, *Nuttall*, *Bigelow*, &c., were founded on their characters of plants which were doubtfully referred to the genera in which they were placed, or were stated to disagree in some particular from the other species. One who, like Rafinesque, followed the easy rule of founding new genera upon all these species, could not fail to make now and then an excellent hit; but as he very seldom knew the plants themselves, he was unable to characterize his proposed genera, or to advance our knowledge respecting them in the slightest degree. In his later publications, this practice is carried to so absurd an extent as entirely to defeat its object.

The *Journal de Physique* for 1819, also contains a memoir entitled *Prodrome des nouveaux genres de plantes observées en* 1817 *et* 1818, *dans l'interieur des Etats-Unis d'Amérique*, which is probably one of Rafinesque's most creditable productions. It comprises fifty genera, founded mostly, but not entirely, upon plants which he had seen, many of which, however, he had previously proposed, under the same or different names. The most favorable specimens are the following, viz. *Nemopanthes*, *Polanisia*, *Lobadium*, *Blephilia*, *Agroseris*, *Stylimnus*, *Ratibida* and *Lepachys* (taken together,) *Cymopterus*, *Marathrum*, *Clintonia*, *Styrandra*, *Peltandra*, *Diarina*, and *Neuroloma*. Nearly half of these are not here proposed for the first time: in some cases he had been anticipated; and in others the names were pre-

occupied.* The following have never been identified, viz. *Discovium, Leptrina, Flexularia, Anthipsimus*, and the five acotyledonous genera. In the same year (1819,) he again published three of these genera, viz. *Cylactis, Nemopanthes*, and *Polanisia*, in the first volume of the *American Journal of Science*, to which he also contributed several short botanical and zoological, or miscellaneous articles.† His botanical writings between the years 1820 and 1830, inclusive, as far as we can ascertain them, are the following, viz.

Annals of Nature, or an Annual Synopsis of New Genera and Species of Animals, Plants, &c., discovered in North America, 1820. A pamphlet of sixteen pages, printed at Lexington, Kentucky: it is chiefly occupied with zoology; but it contains brief characters of about fifty proposed species of plants, three or four of which are possibly new; but we can only vouch for a single species of the number. The four new genera proposed, are no better than the species.‡

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* The worst are *Cylactis* (which is a Rubus,) *Cyphorima* (Lithospermum,) *Endiplus?* (Phacelia,) *Dacistoma* (Gerardia,) *Dasanthera* (founded on the figure and description of Pursh's *Gerardia fruticosa*=Pentstemon,) *Neurosperma* (Momordica,) *Delostylis* (Trillium,) *Critesion* (Hordeum,) *Trisiola* (Uniola,) *Torreya* and *Distymus* (Cyperus,) *Aplostemon* (=Scirpus cæspitosus and S. triqueter!) under which two additional genera are proposed, viz. *Diplarinus* for the *Scirpi* with two stamens, and *Dichismus* for those with two stigmas.

† One of these articles is devoted a consideration of the natural affinities of *Fœrkea;* which he considers as forming a small family along with *Galenia!!* while *Nectris*, to which Pursh united it, is said to stand next to *Myriophyllum!*

‡ *Ilysanthes* is probably Lindernia, incorrectly described. *Peramibus* is founded on a genuine Rudbeckia. *Hedychloe* is Kyllingia pumila. The characters of the two following genera we copy entire, for the edification of cryptogamic botanists: the first is said to be a Fungus, the second an Alga.

"*N. G.* Anastomaria.—Fructification in flexuose lamellar veins, anastomosed like a net.—This genus will be next to *Merulius* and *Dedalea;* some species of them may probably belong to it.—*A. campanulata.* Stipitated fulvous; stipe thick; pericle campanulated; netted outside, margin erose, insides scaly and dark spotted. —This may be the type of the genus. Size, four or five inches. It grows in the State of New York.—*A. dimidiata.* Sessile, dimidiated, imbricated, wrinkled above and fulvous with brown or black zones, netted beneath; veins often bifid near the margin.—Near Catskill, State of New York. It may be the type of a subgenus, *Campsilicus.*

"*N. G.* Stypnion. A floating gelatinous and floccose mass, easily divided and homogeneous, without any perceptible filaments or organs.—A very singular genus, next to my *G. Potarcus.* It differs from *Conferva*, which consists of five fixed filaments, and *Oscillatoria* of interwoven articulated ones. I could not perceive any filaments in it, perhaps a microscope might show some [!!] surrounded by a jelly. The name means *tow* in Greek.—*S. fluitans.* Floating, elongated perpendicularly; amorphous, floccose or lacerated; of a dirty yellowish or brown color.—Very com-

Tracts in the Western Review, about the year 1820. Among them is a *Monograph of North American Roses;* in which thirty-three species indigenous to the United States are described! Also a *Monograph of Houstonia*, in which fourteen species are described, exclusive of the Hedyotis crassifolia of his Florula Ludoviciana, of which he forms a new genus! These tracts, with another on the classification of some natural families, have been reprinted in the fifth, sixth, and seventh volumes of the *Annales Générales des Sciences Physiques*, at Brussels.—The following are unknown to us.

1821. "*Western Minerva;* several new genera; suppressed by my rivals!"

1822. "*The Cosmonist*, twenty numbers, Lexington.—New Plants of Kentucky."

1823. "*Prenanthes Opicrina*, and other plants, Cincinnati."

1824. "*Florula Kentuckensis* and Prodromus N. sp., Lexington." No intimation is given of the place or form of publication.

1824. *First Catalogues and Circulars of the Botanic Garden of Transylvania University*, Kentucky.

1825. *Neogenyton*, or indication of sixty-six new genera of plants of North America.—A loose sheet of four pages, printed at Lexington; and we believe reprinted in Seringe's *Bulletin*. A few good genera are indicated in this tract, but not properly characterized. The best are, *Cladrastis* (Virgilia lutea; upon which he endeavors to establish three or four species,) and *Stylipus*. A few are good, but anticipated by other authors; such as *Helichroa* (in which some seven or eight species are made out of at most three,) which is *Echinacea* of Mœnch; and *Megadenus*, which is *Eleocharis* of Brown; several others may be found to indicate sections or sub-genera; but about fifty of the sixty-six are absolute nonsense.*

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mon on the surface of the Ohio in summer, having the appearance of pieces of ropes or oakum. It smells like *Conferva*." *Rafinesque, l. c. p.* 16.

* Thus, *Tomostigma* is founded upon Draba Caroliniana; *Hartiana*, upon Anemone Caroliniana, &c.; *Stylisma*, on Convolvulus tenellus, is said not to belong to the *Convolvulaceæ*; *Helepta*, with three species, is made from Heliopsis lævis; *Endodia* and *Aplexia* are founded, one on Leersia lenticularis, the other on L. Virginica; three genera are founded upon genuine species of Croton, and one on Stillingia sylvatica, &c. &c. It is but fair to notice, however, that it appears from the species cited, that his *Ptilemnium* is the same with Discopleura, *DC.*, his *Spermolepis* with Leptocaulis, *Nutt.*, and his *Oxypolis* with Archemora, *DC.*, but mixed with an Angelica and Tiedmannia. None of them could have been identified by the characters assigned.

A pamphlet (?) entitled "*Neocloris or New Species of Western America*," is mentioned by Rafinesque, but neither the place nor form of publication are given: we are wholly unacquainted with it.

1826. "*School of Flora*, with figures, Philadelphia."

1828. "*Neophyton Botanicon*, or New Plants of North America."—*Medical Flora of the United States*, vol. 1, 12mo. Philadelphia. The second volume was published in 1830. It is illustrated with rather rude wood cuts, and contains much information respecting the plants employed in popular medicine.

1830. *American Manual of the Grape Vines, and the Art of Making Wine.* Philadelphia: a pamphlet of sixty-four pages, 12mo.—He describes sixty-two species of grape, of which forty are natives of the United States! One hundred varieties of our species are characterized!—"*Botanical Letters to De Candolle.*"

A gradual deterioration will be observed in Rafinesque's botanical writings from 1819* to about 1830, when the passion for establishing new genera and species, appears to have become a complete *monomania*. This is the most charitable supposition we can entertain, and is confirmed by the opinions of those who knew him best. Hitherto we have been particular in the enumeration of his scattered productions, in order to facilitate the labors of those who may be disposed to search through bushels of chaff for the grain or two of wheat they perchance contain. What consideration they may deserve, let succeeding botanists determine; but we cannot hesitate to assert that none whatever is due to his subsequent works. These, like many of the preceding, are little known; but we shall continue our enumeration, and future writers can correct our opinion wherever they think we have done the author injustice.

1832. "*The American Florist:* thirty-six figures, 12mo. Philadelphia." With this we are unacquainted.—*Atlantic Journal, and Friend of Knowledge.* A periodical of which eight

* It was in this year (1819) that I became alarmed by a flood of communications, announcing new discoveries by C. S. Rafinesque, and being warned, both at home and abroad, against his claims, I returned him a large bundle of memoirs, prepared with his beautiful and exact chirography, and in the neatest form of scientific papers. This will account for the early disappearance of his communications from this Journal. The step was painful, but necessary; for, if there had been no other difficulty, he alone would have filled the Journal, had he been permitted to proceed.—Sen. Editor.

numbers appeared in 1832 and 1833; published at Philadelphia. The whole forms an 8vo. volume of 212 pages. Its contents are miscellaneous, but there are several botanical articles, in which, of course, new genera and species are described. In one of these articles, Rafinesque takes up Dr. Torrey's account of the plants collected by Dr. James, in Long's expedition to the Rocky Mountains, (published in the second volume of the Annals of the Lyceum of Natural History, New York,) upon which he creates twenty new genera! In another, he describes two new genera of *Umbelliferæ* called *Streblanthus* and *Orimaria*; one of which is an *Eryngium* falsely characterized; the other, a *Bupleurum* (which had doubtless escaped from some garden) in an undeveloped state, which we happen to know Rafinesque had mistaken for a grass, and described as a new genus of that family; but, being told it was a Bupleurum, he has accordingly published it as a new genus "near to Bupleurum."

1833. *Herbarium Rafinesquianum.* Loose sheets, printed in 24mo., we believe at different times, and reaching to about eighty pages. The first part is chiefly a reprint from the last number of his Atlantic Journal; the second contains a list of his botanical works, and account of plants offered for sale, a monograph of *Samolus* increased to ten species, of the American species of *Cypripedium* increased to ten species, of *Spiranthes*, ten species, and of *Jeffersonia* and *Podophyllum*, each increased to four species. The remainder is of the same character.

1836. *Flora Telluriana*: four parts; each of about one hundred pages, 8vo.; the fourth part, or supplement published in 1838.—*New Flora and Botany of North America; being a supplemental flora to the various botanical works of Michaux, Muhlenberg, Pursh, &c. &c. &c.* Philadelphia: printed for the author and publisher. Four parts are mentioned; but we have seen only three, of about one hundred pages each.

The object proposed in the *Flora Telluriana* is general generic reform; and the author informs his readers, that "although the attempt may astonish or perplex some timid botanists," he intends to establish about *one thousand totally new genera*, including some of those he had formerly published:* it is needless to add, that in this and the *New Flora of North America*, together, he has nearly fulfilled his promise. According to his principles,

* *Flora Telluriana*, Introduction, p. 15.

this business of establishing new genera and species will be endless; for he insists, in his later works particularly, that both new species and new genera are continually produced by the deviation of existing forms, which at length give rise to new species, if the foliage only is changed, and new genera when the floral organs are affected. He assumes thirty to one hundred years as the average time required for the production of a new species, and five hundred to one thousand years for a new genus; and on a preceding page he remarks,* that "new varieties and species were often met with by me at long intervals, in wild places well explored before, grown from seeds of akin species." "It is even possible," he continues, "to ascertain the relative ages and affinities of actual species and genera. . . . . As a general rule, the real genera of single or few species, are the newest in order of time, and the most prolific, the eldest in the series."†

It is therefore of little consequence, that half his genera and species do not really exist at present, since they may perchance make their appearance a century hence.‡ Our notice of these extraordinary works must be very brief. The first and most amusing part of the *Flora Telluriana*, is chiefly occupied with the author's views of natural classification, upon which we have already made some remarks. This is followed by "The fifty rules of generic nomenclature, by *Linnæus and Rafinesque!*" In the second, the business of making genera is begun in earnest, and continued through the work. Thus *Allium* is divided into fifteen genera; Solidago, into seven, with about twice as many sub-genera; *Saxifraga*, into twelve genera, which are placed in three natural orders, and two different classes; *Polygonum* into twenty-three; *Gentiana*, (as left by Grisebach,) into fourteen; *Linum*, into thirty-four; *Hypericum* into eleven; and *Salvia*, into fourteen genera absolutely, and fourteen more proposed as doubtful or perhaps sub-genera. "As I have not yet heard of a genus dedi-

* *Op. cit. p.* 12.—Vid. also *New Flora, &c. p.* 16. † *Op. cit. p.* 14.

‡ "Thus it is needless to dispute and differ about new genera, species and varieties. Every variety is a deviation which becomes a species as soon as it is permanent by reproduction. Deviations in essential organs may thus gradually become new genera. Yet every deviation in form, ought to have a peculiar name, and it is better to have only a generic and specific name for it, than four when deemed a variety." *Rafinesque, in Atlantic Journal, p.* 164. "All our actual species of Roses, Grapes, Oaks, Plums, Apples, Currants, Asters, Azaleas, Heaths, &c., have thus been formed. Nay, it is so probably with every genuine genus of many species." *Herbar. Rafin. p.* 15.

cated to me," he remarks in the introduction, "I shall perhaps have to imitate Roxburgh, and choose one for myself, as a *Rafinesquia.*" It is not true that Roxburgh dedicated a genus to himself. This honor was reserved for Rafinesque, who accordingly appropriated the *Lotus pinnatus* of the Botanical Magazine, and described it in due form as RAFINESQUIA seu *Flundula*, the second name being proposed as a substitute in case this honor had been already conferred by some other person. But as the plant turned out to be an *Hosackia*, he is obliged to make another trial; and in the preamble to the third part, he continues: "As to a *Rafinesquia*, I have provided half a dozen, out of which I hope some one will suit the fancy of botanists and be adopted; although I may be blamed for this conceit, I blame instead for it those makers of new genera, that dedicate them to obscure individuals, that have not added one page to the science; and have not thought of me for forty years, who have added one thousand pages to it, and three thousand new genera or species."* His next choice falls upon the beautiful *Gardoquia Hookeri!* which is published in due form as the second RAFINESQUIA of *Rafinesque;*† and of which he makes two species in his New Flora of North America.

The last named work is precisely of the same character with the preceding, except that the new genera are not quite so numerous, but the new species amply supply the deficiency. Several of the former are made in this way: "Actimeris, *Raf.*, misspelt *Actinomeris* by Nuttall; *Actispermum*, Raf., misspelt *Actinospermum* by Elliott." As to species, the following may suffice for examples. A single *Amphicarpæa* is divided into ten species in two genera, *Bellis integrifolia* into four species, *Capsella Bursa-pastoris* into seven species and one new genus besides, *Prunella vulgaris* into ten species, two species of *Triosteum* into eight, a single (?) *Eclipta* into ten or twelve species and apparently three genera, &c. &c. These are by no means unusual instances, but fairly exhibit the character of the work.

1839. *American Manual of the Mulberry Trees.* Philadelphia. Of this pamphlet we have seen no more than the title-page and the first sheet.

1840. *The Good Book and Amenities of Nature; or Annals of Historical and Natural Sciences*, is the last we have to notice.

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* *Flora Telluriana, part* 3, *p.* 6. † *Op. cit. part* 3, *p.* 82.

We have only seen a few sheets of this miscellaneous work, which purports to be the commencement of a periodical or occasional publication. The first article is a general classification of the sciences comprised in "*Cosmosy*, or Natural History." Here we meet with such names as the following branches of *Astrography*, viz. "*Astrosy*, *Heliosy*, *Tholosy*, *Selenosy*, *Cometosy*, *Toxosy*, &c., applying to the stars, the sun, the planets, the moons, the comets, and the various *Tixomes* (other bodies) of the skies;" as well as "*Atmology*, the science of the atmosphere," with its branches, such as "*Yetology*, of rains; *Phosology*, of luminous meteors;" not to mention *Dimnology*, *Potamology*, *Stromology*, *Spilology*, *Volcanology*, *Stocology*, *Etherology*, *Gazology*, *Gazomy*, *Uxromy*, *Flogomy*, "the flogomes, or burning substances," *Campsology*, &c., &c., &c. This reminds us of a paper which Rafinesque many years ago sent to the editor of a well known scientific journal, describing and characterizing, in natural history style, *twelve new species of thunder and lightning!* But the only botanical article we have seen is a "*Revision of the Carexides*," in which the simple genus *Carex* is divided into two sub-families and eighteen genera: and we observe that the same species, under different names, are frequently cited as the types of two or three different genera. With this, so far as we can ascertain, the last botanical article of this indefatigable writer, we close our remarks, which many readers will probably consider unreasonably prolix.* A. G.

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* Mr. Rafinesque's papers on Zoology, Fossil Remains, &c. are numerous; but we are not prepared to enumerate them. The following are some of his more considerable miscellaneous works, exclusive of those previously mentioned, viz.

The American Nations; or outlines of their general history, ancient and modern, including the whole history of the earth and mankind in the western hemisphere, &c. &c. Vol. I. Philadelphia, (published by the author,) 1836. 8vo. pp. 560. Vol. II, is also said to be published.

Safe Banking; including the principles of wealth. Philadelphia, 1837. 12mo. pp. 136.

Celestial Wonders and Philosophy of the Visible Heavens. 1839.

Genius and Spirit of the Hebrew Bible, &c.

The World, or Instability; a Poem in twenty parts: with notes and illustrations. Philadelphia, (J. Dobson,) 1836. 8vo. pp. 248.

ART. II.—*Abstract of a Letter to Baron A. Humboldt, upon the Invention of the Mariner's Compass.*—Lettre à M. le Baron A. de Humboldt, sur l'Invention de la Boussole; par M. J. KLAPROTH. Paris: 1834. pp. 138.

Read before the Connecticut Academy of Arts and Sciences, by EDWARD E. SALISBURY, A. M., and published by permission of the Academy.

THIS is the title of a little volume, published six years ago, in which M. Klaproth, a well known orientalist, since deceased,* has given the result of researches made by him, respecting the invention of the mariner's compass.

It has been long since generally admitted, that the classic writers, though they had some idea of the attracting and repelling power of the magnet, were ignorant of its polarity, and consequently of its applicability to navigation. But the later opinion, that the merit of this discovery is to be attributed to an Italian of the middle age, must be also abandoned. Klaproth's investigations go to prove, that our knowledge of the magnet, as well as of the magnetic needle and compass, has been derived, either directly or indirectly, from the East, and originally from China, where the earliest notices of both belong.

Should this work not have become known already in this country, a brief abstract of its most important points may not be unentertaining or without value.

The name *magnet* comes from the Greek. The most ancient Greek name for this natural production was λίθος Ἡρακλεῖα, *stone of Heraclea*, a city situated at the foot of Mt. Sipylus, in Lydia. This city was afterwards called Magnesia, and the name of the stone, for which it was remarkable, became changed to Μάγνησιος λίθος, *stone of Magnesia*, or vulgarly, Μάγνης, and Μάγνητῆς. The same name is found in the Latin, and its origin from the Greek is confirmed by Lucretius, who says

> "Quem magneta vocant patrio de nomine Graii:
> Magnetem, quia sit patriis in montibus ortus."

Other languages into which the name *magnet* has been incorporated, are the modern Greek, (Μάγνητῆς,) the German, (*magnet,*) the Hollandish, (*magneet-stein,*) the Danish, (*magneet,*) the Swedish, (*magnet,*) the language of the Grisons, in the dialect of

* M. Klaproth was a Prussian, born at Berlin in 1783, and died at Paris in 1835.

Surselva, (*magnêt,*) the Hungarian, (*magnet-kö,*) the Russian, (*magnët,*) the Polish, (*magnes, magnet,* and *magnet kamien,*) and the Vendish of Styria, (*magnet,*) where, excepting in the modern Greek, the Latin has unquestionably been the medium of transporting the word from the ancient Greek.

Another name in use in several European idioms, as in the Greek, Italian, French, the Romançe language of Surset, the Bosnian, Croatian, and the Vendish of Styria, is *calamita.* This word appears to be of Greek origin, and is given by Pliny as the name of a *small green frog.* The application of the term to the magnet is explained by a fancied resemblance to that animal in the magnetic needle, when poised on water by means of small reeds, projecting beneath it like the legs of a frog in motion, according to the usual mode in early times, in Europe, of adapting it to the mariner's use. But that the idea of such a resemblance was not original in Europe, one might be led to suspect, from the analogy of the Birman name for the compass *anghmyaoung,* which signifies *lizard,* and will be rendered still more probable by evidence, hereafter to be given, that this mode of using the magnetic needle in navigation, was adopted in China about eighty years previous to the earliest mention of the needle itself in any European writer.

Many of the terms applied to the magnet, both in European and Asiatic languages, allude to one or another of its characteristic properties. Among these, the French *l'aimant, the lover,* and the Spanish and Portuguese *iman,* with the same signification, is particularly worthy of notice, as having its precise correspondent in the Chinese *thsu chy,* of which a celebrated Chinese naturalist who flourished in 1580, observes: "if this stone had not a love for the iron, it would not make it come to it," and a writer of an age eight centuries earlier: "The magnet draws the iron like a tender mother, who causes her children to come to her, and it is for this reason, that it has received its name." In India also, the magnet was of old personified as capable of tender attachment, in the Sanscrit name *thoumbaka, the kisser,* from which are derived several appellations now in use in that country, as *tchoumbok* in the Bengalee, and *tchambak* in the Hindostanee. Another Sanscrit term for the magnet is *ayaskânta, the loved stone,* or *ayaskânta-mani, the stone loved by iron,* which also the Bengalee retains; and in the Cingalese the magnet bears the name of *kândakô-galah, the stone that loves,* which is ap-

parently composed of the Sanscrit *kánta, loving*, and the Cingalese *galah, stone.*

The languages of Mussulman Asia derive the names which they give to the magnet, mostly, from the Greek Μάγνητις: thus in Arabic we find *al-mâghnâthis;* in Persian *seng-i-maghnâthis —the stone maghnâthis;* and in Turkish *miknâthis.*

Of the names given to the magnetic needle and compass, one which is to be met with in many European languages, is the Italian *boussola*, the Portuguese *bussola*, the Spanish *brujula*, the French *boussole*, &c. Some Italian authors have claimed this term as original in their own language, and have sought to argue, from its having been so widely adopted in other languages, in favor of their national assumption of the honor of having invented the compass. The word cannot, however, be deduced from an Italian origin any more reasonably than from an assumed English diminutive *boxel*, no such diminutive existing, which some writers have attempted; nor does the Greek Μπόσουλας, bear the appearance of being original with that language. The derivation of both the Greek Μπόσουλας, and the Italian *boussola*, and so of the corresponding words in other languages of Europe, is to be found in the Arabic *mouassala—arrow*, an initial *m* of Arabic words, having been very commonly changed, in the middle age, to *b. Mouassala* is itself one of the names given to the magnetic needle in Arabic.

Among the Turks and Persians, the term for the compass, in most general use, is *kibléh-naméh*, or *kibléh-numa—indicator of the kibléh*, which is the direction to be faced in prayer, and consequently, as Mecca lies to the south of most of the Mohammedan countries, *the south.* With this is perfectly synonymous the Chinese apellation *tchi nan—indicator of the south*, and the Mandchow *dchoulesi dchorikoú*, for the magnetic needle. The Persians undoubtedly derived their name for the compass, *kibléh-naméh*, from the Chinese, for it is a peculiarity limited to the Chinese and those who have adopted their civilization, that they make the south their principal pole, regarding this as the anterior and the north as the posterior side of the world; according to which they also place the throne of their Emperor, and the principal façade of their edifices, so as to front the south.

As the Hindoos have never been addicted to navigation, the knowledge of the compass seems to have been introduced but very late among them, and the names they give to it are for the

most part foreign. In the English provinces of India it is called *compass*, from the English; and in the Cingalese of Ceylon, *kompâsouwa*, a corruption of *compass*. The Hindostanee has adopted the Persian term *kibléh-numa—indicator of the south.*

In these comparisons of the most current terms for the magnet and the magnetic needle and compass, in the eastern and western world, there is not a little to lead one to believe that the discovery of the wonderful properties of the magnet originated in the remote Orient, and was gradually communicated to the nations of the west. But there are historic notices of the magnetic needle and compass, which also point to the east as the field of the first discovery of the polarity of the magnet and its applicability to navigation.

The earliest explicit mention of the magnetic needle, by any European writer, is in a poetical work of Guyot de Provins, dating about the year 1190. The next as to date is found in the *Historia Orientalis* of Jacques de Vitry, referring to the year 1204: "Adamas in Indiâ reperitur—ferrum occultâ quâdam naturâ ad se trahit. Acus ferrea, postquam adamantem contigerit, ad stellam septentrionalem, quae velut axis fermamenti, aliis vergentibus, non movetur, semper convertitur, unde valdé necessarius est navigantibus in mari." It would be difficult to give any authority to this passage, and not recognize the east as the source of knowledge, among Europeans, of the polarity of the magnet. Not long before the year 1260, Brunetto Latini, "mâitre du divin Dante," being on a journey in England, saw the magnet and the magnetic needle for the first time, in visiting Roger Bacon, and a fragment of a letter of his, written on the occasion, which has been preserved, describes them thus: "He shew me the magnet, a disagreeably looking black stone it readily unites with iron; a small needle is taken into the hand and fastened in a bit of reed, then it is put upon a surface of water, and one stands over it, and the point turns towards the star, (the polar star;) in case the night is obscure, and neither star nor moon is seen, the mariner may keep to his right course."

Albertus Magnus, of Swabia, who flourished about the middle of the thirteenth century, quotes in a work of his, "*De Mineralibus*," a passage from a "treatise concerning stones," attributed to Aristotle, of which the following portion merits particular attention: "Angulus magnetis cujusdam est, cujus virtus apprehendi

ferrum est ad *zoron*, hoc est septentrionalem, et hoc utuntur nautæ. Angulus verò alius magnetis illi oppositus trahit ad *aphron*, id est meridionalem: et si approximes ferrum versus angulum zoron, convertit se ferrum ad zoron, et si ad oppositum angulum approximes, convertit se directè ad aphron." Vincent de Beauvais, a cotemporary of Albertus Magnus, has left a similar passage, likewise quoting Aristotle, in his "*Speculum Naturale:*" "Angulus quidem ejus cui virtus est attrahendi ferrum, est ad *zaron*, i. e. septentrionalem, angulus autem oppositus, ad *aphron*, i. e. meridiem. Itaque proprietatem habet magnes, quod si approximes ei ferrum ad angulum ipsius qui zaron, i. e. septentrionem respicit, ad septentrionem se convertit, si verò ad angulum oppositum ferrum admoveris, ad aphron, i. e. meridiem se movebit." The names given in these two passages to the north and south pole, *zoron* or *zaron*, and *aphron*, are the Arabic ظهر—*north*, and اور—*south*. As to the work here attributed to Aristotle, under the title of a "treatise concerning stones," we have no such Greek text of this author, and it is doubtful if ever he wrote such a book. There is an Arabic treatise entitled كتاب الحجار—*the Book of Stones*, composed by a certain Lucas, son of Serapion, but purporting to be a translation from Aristotle, which Baron De Sacy has shown to be the true source of citations under the name of Aristotle, in the writings of Tëifachi and Bëilak Kibdjaki; and very probably Albert and Vincent have quoted this same work in their account of the polarity of the magnet. However, the names *zoron* and *aphron*, applied by these authors to the two magnetic poles, are sufficient to prove that they derived their knowledge of the magnet's polarity from an oriental source.

But there is no evidence that the Arabs were the inventors of the magnetic needle. It may, indeed, have been in use among the Arabian navigators, before it was noticed by men of science; but we have in no Arabic work any mention of it which goes back beyond the year 1242. In this year, Bëilak Kibdjaki made a voyage from Tripoli to Alexandria, and in his treatise entitled كتاب كنز التجار فى معرفة الحجار—*the Treasure of Merchants, touching the knowledge of stones*, he has recorded his observations on that occasion, respecting the magnetic needle. "As to the properties of the magnetic needle," he writes, "it is to be observed, that the captains who navigate the sea of Syria, when the night is so obscure that they can see no star by which to steer

their course according to the four cardinal points, place a pitcher full of water in the interior of the vessel, to be sheltered from the wind, and then take a needle and pass it through a piece of wood or reed, forming a cross, which they throw into the water in the pitcher prepared for the purpose, and it floats. They then take a magnet large enough to fill the palm of the hand, or smaller, and bring it near the surface of the water, giving their hands a rotatory movement towards the right, so that the needle turns about on the surface of the water. Then they withdraw their hands all of a sudden, and truly the needle points north and south. I myself saw this done on my voyage from Tripoli in Syria to Alexandria, in the year 640," (or 1242 of our era.) "They say," he continues, "that the captains who navigate the Indian ocean supply the needle and piece of wood by a sort of fish, of thin iron, hollow, and so made with them, that, when thrown into the water it floats, and shows by its head and tail the two points of north and south." So early, then, as the year 1242, the water-compass was in general use on the Syrian waters, and was known, it is to be presumed, as well to Arabian as to European navigators. But what this author, Bëilak, says of the peculiar form, according to report, of the magnetic needle which was used in the Indian ocean, indicates an independent knowledge of it in that quarter of the globe; and recalling the signification of *calamita, little green frog*, and the Burman appellation for the compass, meaning *lizard*, leads one to look further to the east than any of the Mohammedan countries for the original discovery of the polaric properties of the magnet. We shall presently see that between 1111 and 1117, the Chinese made a water-compass exactly such as Bëilak describes that which he saw in 1242, in the Syrian waters, and also like that which Jacques de Vitry saw within the first half of the thirteenth century, in the possession of Roger Bacon.

The Chinese have been acquainted with the magnet and its attractive force and polarity from the highest antiquity. In a Chinese dictionary, composed in 121, by Hiu-tchin, the magnet is mentioned, as a "stone with which one can give direction to the needle." About a hundred years later, as we learn from P. Gaubil, in his history of the dynasty of the Thâng, there is found a distinct notice of the compass as an instrument by which to ascertain the points of north and south. Under the dynasty of the Tsin, (i. e. between 265 and 419,) Chinese vessels were already

steered to the south by means of the magnet. But the Chinese were acquainted with the declination of the needle, also, a long while before it was supposed to be first discovered by Columbus. In a medical natural history, composed between the years 1111 and 1117, the author gives the following notice of the magnet and of its properties. This is the most ancient *description* of the magnet found as yet in any Chinese book: "The magnet is covered over with little bristles slightly red, and its superficies is rough. It attracts iron, and unites itself with it; and for this reason it is commonly called 'the stone which licks up iron.' When an iron point is rubbed upon the magnet, it acquires the property of pointing to the south; yet it always declines eastward, and is not perfectly true to the south. On this account, a thread of new cotton is taken and attached by a particle of wax as large as a mustard-seed, exactly to the middle of the iron, which is thus suspended in some place where there is no wind. The needle then points, without variation, to the south. If the needle is passed through a little tube of thin reed, which is afterwards placed on water, it directs to the south, but always with a declination to the point *ping*, that is to say, east $\frac{1}{6}$ south." The accuracy of this observation, referring it to the capital city of the empire, is confirmed by P. Amiot, who, after taking magnetic observations at Peking for several years, found the variation of the needle there to be constantly from 2° to 2° 30′.

Upon a due consideration of all these historic data, in connection with the comparison of the European and Oriental names of the magnet, the magnetic needle, and the compass, it cannot appear to any one to be a rash conclusion, that the knowledge of the natural production, as well as of its wonderful applicability in navigation, existed first in China, and was communicated by the intervention of the Arabs to the nations of Europe, probably on occasion of the more frequent intercourse between Europe and the East to which the Crusades gave rise.

But before the Chinese had applied the magnet to use in navigation, it was employed among them in the construction of *magnetic cars* by which travellers on land directed their course. Not to cite those stories of the Chinese relative to these cars which lose themselves in a fabulous antiquity, the earliest historic allusion to them dates in the first half of the second century, when the Emperor Tcheou Koung, as it is related, gave to some embassadors from Tonkin and Cochin-China "five travelling cars,

so constructed as always to indicate the direction of the south.—The cars which showed the south," it is added, "always went in front, to show the way to those who were behind, and to make known the four cardinal points." In the year 235, a Chinese emperor ordered one Makiun to construct a "car which would show the south," to be deposited in a sort of Museum; and we are informed that the invention had then, for some time, been lost, and was recovered by the ingenuity of Makiun. In a book of annals of the dynasty of the Tsin, the magnetic car of a previous age is thus described: "The figure sculptured in wood, standing upon the magnetic car, represented a genius dressed in feathers. In whatever direction the car inclined or turned, the hand of the genius pointed invariably to the south. When the Emperor went out in form, in his carriage, this car led the van, and served to show the four cardinal points." From the year 235, the construction of a magnetic car seems to have been a puzzle which different Chinese emperors proposed to the ingenious men of their courts, and the knowledge of the invention appears to have been confined within very narrow limits.

Between 806 and 820, under the Thâng dynasty, were first constructed cars called *Kin koung yuan.* These were magnetic cars to which had been added a sort of drum called *Ki li kou,* a piece of mechanism which may remind one of some curious public time-pieces still to be seen in old cities of Europe. A *drum-car* is thus described by a Chinese author: "It had two stories, in each of which was a wooden man holding erect a mallet of wood. As soon as the car had run one *ly,** the wooden man of the lower story struck a blow upon a drum, and a wheel placed at the middle of his height made one revolution. After the car had run ten *lys*, the wooden man of the upper story struck a little bell."

The magnetic car cannot be traced later than 1609. In that year was published a celebrated Encyclopedia, which contains the following passage, accompanying a design of the human figure which was placed upon the magnetic car: "This is a car ornament, of which the dimensions are as follows: It is one foot and four inches in height, and in breadth at the bottom seven inches and four lines. At the extremity of the axle-tree of the car is pierced a round hole of three inches and seven lines in diameter. In this hole moves a peg of the same size, on which is

* A measure of distance variously estimated. John Francis Davis, in his *History of China*, computes thirty *lys* in one English mile.

placed the figure of a man sculptured in *jade*,* whose hand always points to the south. This figure had motion in the hole, and turned. In the years Yan Yeou, (from 1314 to 1320,) it was an object to determine the position of the monastery of Yao mou ngan, and the figure on the magnetic car was made use of for this purpose."

ART. III.—*A Method of determining the Temperature of the Mercury in a Siphon Barometer, from the observed upper and lower readings; and of testing the accuracy of the instrument;* by FARRAND N. BENEDICT, Prof. Math. and Civil Engineering, Univ. of Vermont.

IT has long been known that a true determination of the temperature of the mercurial column, is essential to the accuracy of barometrical results. The apparatus now in use for this purpose is a thermometer encased in the brass mounting, with its bulb contiguous to the tube of the barometer. While there can be no doubt that the attached thermometer has answered a useful purpose for indicating approximately the temperature of the mercurial column, it is equally evident that its indications are not to be relied upon in many cases within the requisite limits of exactness. These cases, in the present state of science, are the most common and generally the most interesting. When the subjects of investigation are such as to admit of a choice of the places of observation, as the vaults of observatories or large and deep cellars, the temperature may be assigned with all necessary precision. But in the most of physical questions, like those relating to the barometrical measurement of altitudes or to detecting the horary and diurnal variations of atmospheric pressure, the errors incident to this mode of appreciating the temperature, under ordinary circumstances, are necessarily considerable. To entitle the attached thermometer to confidence, its bulb should be a long cylinder, of a diameter equal to that of the barometric tube, and similarly exposed to the surrounding influences of temperature. But these conditions have proved difficult to satisfy. Bunten's mountain barometer, which is probably the most perfect portable instrument of the kind now in use, is faulty in each of these respects, and, to a great extent, necessarily so. The brass mounting is a hollow cylinder with two rectangular orifices nearly op-

* A hard stone, of variegated hue.

posite to each other, about four tenths of an inch wide, parallel to the axis, and extending 9 or 10 inches from the extremities towards the centre. The design of this is to expose to view the extremities of the column, and to allow the requisite movement to the vernier. The remaining central portion, which is about 15 inches in length, and has no perforation through its surface, embraces the attached thermometer. This arrangement evidently exposes the bulb and the tube to different influences. The bulb is comparatively small, and its connection with the mounting is more intimate than it is with the tube, and consequently it tends to indicate the temperature of the former more truly than that of the latter; and more especially so as a like connection between the tube and the mounting is unattainable with a due regard to the safety of the instrument. And besides, allowing the attached thermometer to mark truly the temperature of that part of the column in its vicinity, and which, like it, is protected by the mounting, it might materially err in respect to the remaining portions which are exposed to the direct and variable influences of the atmosphere. These remarks, suggested by the construction of the instrument, I verified experimentally in the following manner. I filled with mercury a tube 14 inches long and of a diameter not much larger than that of the barometric tube, and inserted into the open end a tube of less diameter; joining the two firmly with sealing wax. This was introduced into the central part of the brass mounting. I took a series of observations with this instrument in a cellar where the temperature was low and uniform, and another series in a room where the temperature was high and also uniform. In both these series of observations the temperature indicated by the attached thermometer must have been very nearly the same as that of the mercury in the tube. Denoting the means of these temperatures by $(t,)$ (t'') respectively, and the mean altitudes of the upper surface of the mercury by $(a,)$ $(a'',)$ we evidently have $t''=t+A(a''-a)$; A being a constant depending upon the volume of mercury and the diameter of the lesser tube. For the same reason, if (t') is the temperature of the mercury at any other time, and (a') the reading of the upper surface, we have $t'=t+A(a'-a)$. Eliminating the constant A between these two equations, and resolving for $(t',)$ there results $t'=\frac{t''-t}{a''-a}(a'-a)+t$ (1). I then made the following observations.

1		31.1	31.1	31.1		
2	5′	43.8	42.8	39.0	4.8	3.8
3	10′	56.5	53.6	49.1	7.4	4.5
4	15′	63.6	60.0	56.2	7.4	3.8
5	20′	67.8	64.4	62.2	5.6	2.2
6	25′	69.4	67.3	65.9	3.5	1.4
7	30′	70.0	68.9	67.6	2.4	1.3
8	35′	70.0	69.8	69.0	1.0	0.8

The first observation was made in a large unoccupied room where the instrument, having been suspended for some hours, indicated a temperature of 31.1 degrees Fah. The instrument was then quickly removed, together with the detached thermometer, to a room at the temperature of 70 degrees, in which all the succeeding observations were made. The second vertical column expresses the time in minutes after the first observation. The 3d, 4th and 5th express in that order the temperatures of the detached and attached thermometers, and of the mercury in the tube, calculated according to formula (1). The 6th and 7th columns express respectively the number of degrees the temperature of the mercury in the tube was behind the attached and detached thermometers. From this table it appears that, after the barometer had been suspended a quarter of an hour for example, the detached thermometer errs as an index of the temperature of the mercurial column by 7.4 degrees, and the attached thermometer by 3.8 degrees; and that the corresponding errors, after half an hour's suspension, are 2°.4 and 1°.3 respectively. These errors would have been somewhat diminished if the diameter of the tube had been strictly equal to that of the barometric one; but on the other hand they might have been aggravated and rendered more uncertain if the tube had been as long as the barometric one, and had not the temperature of the room been sustained at an uniform height. The observations of the table were made with care under circumstances favorable to accuracy, and were verified by three or four other tables, with which it substantially agreed. From the frequency of the observations, some slight errors of time may have been committed, but too inconsiderable to affect the particular object of the experiment.

We conclude therefore that the attached thermometer is an uncertain index of the temperature of the mercurial column, except in those rare cases when the temperature of the air is known to be uniform, and not even then until after nearly an hour's suspension of the barometer.

To appreciate the temperature of the mercurial column throughout its whole extent, in a siphon barometer of which the two branches are cylinders of equal diameters, I propose the following method.

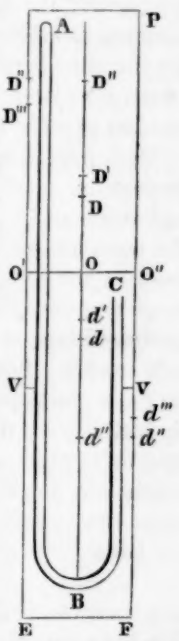
Let ABC represent the tube of a siphon barometer, of which those portions at least within the ranges of the mercurial surfaces are cylinders of equal diameters; and let O be the zero point of the scale D″B, which is supposed to be inexpansible by heat.

Suppose the summits of the convex surfaces of the column in the two branches, at any time, are at D, *d*; and put OD = upper reading = *a*

Od = lower reading = *b*

temperature = *t*

Fig. 1.



If the temperature increases to (t',) while the atmospheric pressure remains unchanged, the masses of mercury in the two branches will evidently not be altered, and the surfaces will rise to some points D′, *d*′. Suppose now the temperature (t') to be constant, and the atmospheric pressure to increase. For the sake of reference to the figure, we have supposed the temperature and pressure, whenever they change to increase; but this can lead to no error when the contrary is the case, as an erroneous supposition would be corrected by the sign. Consequent upon this increase of pressure, the surface *d*′ will descend to some point *d*″, and the surface D′ will ascend to some point D″. Since the tube D′D″ contains a volume of mercury equal to that which *d*′*d*″ did under the first pressure with the temperature (t',) and since the diameters of these tubes are equal, their altitudes must be equal, and therefore

$$D'D'' = d'd''; \quad (1.)$$

If (ε) represents the ratio of expansion in height of mercury in a cylindric glass tube, due to one centigrade degree; and (p,) (p') the altitudes of cylinders having diameters equal to those of the barometric tube within the ranges of the mercurial surfaces, and capacities respectively equivalent to the volumes of mercury in the longer and shorter branches of the siphon at the epoch of the first observation when the temperature was (t;) we have

$$DD' = \varepsilon(t' - t)p$$
$$dd' = \varepsilon(t' - t)p',$$
and therefore $DD' + dd' = \varepsilon(t' - t)(p + p')$.
We derive from the figure $D'D'' = OD'' - OD - DD'$
$$d'd'' = Od'' - Od + dd'.$$

Equating the second members of these last equations, according to (1), and denoting the upper reading OD'' by $(a_{,})$, and the lower reading Od'' by $(b_{,})$, and substituting for $DD' + dd'$ its value expressed above; we have $a_{,} - b_{,} - (a - b) = \varepsilon(t' - t)(p + p')$, (2) which is of the form $a_{,} - b_{,} - (a - b) = A(t' - t)$, (3) where A is a constant co-efficient, since (ε) is constant, and $(p + p')$ is constant for the same barometer. This equation exhibits the relation between the elements of any two sets of observations, on the supposition that the scale is not affected by a change of temperature.

To correct this for the expansion of the scale, let $D''EFP$ represent the brass mounting which bears the scale $D''O'O''F$; and suppose the imaginary zero point O to have been assumed in the same horizontal line with the zero point O' or O'' of the brass scale at the temperature (t). Since the expansion of brass is more than twice that of glass, there can be but one point in the graduated line, at which the glass tube and mounting are invariably united. Let this point be V; and put $OV = f$. Let D''', d''' be those points in the brass scale, which are conveyed to D'', d'' respectively by the augmentation $(t' - t)$ of temperature. Denoting by (ε') the ratio of expansion of brass in length due to one centigrade degree, and by (a'), (b') the distances $O'D'''$, $O''d'''$ respectively, which are the actual readings at the temperature (t'); we have
$$D''D''' = \varepsilon'(t' - t)(a' + f)$$
$$d''d''' = \varepsilon'(t' - t)(b' - f,)$$
and therefore $D''D''' - d''d''' = \varepsilon'(t' - t)(a' - b' + 2f.)$
We have from the figure $O'D'' = O'D''' + D''D'''$ (3')
$$O''d'' = O''d''' + d''d'''\ (3''.)$$
Subtracting the latter of these last two equations from the former, and employing the notation and the above value of $D''D''' - d''d'''$, we have $a_{,} - b_{,} = a' - b' + \varepsilon'(t' - t)(a' - b' + 2f.)$
Eliminating $(a_{,} - b_{,})$ between this equation and (2) there results
$$a' - b' - (a - b) = \varepsilon(t' - t)(p + p') - \varepsilon'(t' - t)(a' - b' + 2f,)\ (4).$$
Since the quantity $(a' - b')$ in cylindrical siphon barometers differs from a constant by only about 4 millimètres for a change of 30 centigrade degrees in the value of $(t' - t',)$ and since (ε') is less

than 0.00002, $\varepsilon'(t'-t)$ $(a'-b'+2f)$ can rarely differ from a constant mean so much as 0.0009. Wherefore, putting

$$\varepsilon'(a'-b'+2f)=A', \text{ a constant, } (5)$$

equation (3) becomes $a'-b'-(a-b)=(A-A')$ $(t'-t,)$ (6.)

This equation is of the same form as (3,) differing from it only in the value of the co-efficient of $(t'-t,)$ and expresses the relation between the elements of any two sets of observations, embracing the corrections for the expansions of the mercury, scale, and glass tube.

If the volume of mercury $(p+p',)$ with which the barometer is charged, were known, as may have been determined with exactness by weighing the instrument before and after filling; and also the point at which the tube and mounting are united, which makes known the value of $(f,)$ then would A and A′ be known; and (6) would give us

$$t'=t+\frac{a'-b'-(a-b)}{A-A'}; \quad (7)$$

which shews the mean temperature of the whole column in terms of the constants A, A′, $(a,)$ $(b,)$ $(t.)$

But if A and A′ are not known with great exactness; if we compare the elements (a'') (b'') (t'') of any other observation, with $(a,)$ $(b,)$ $(t,)$ we have in like manner

$$a''-b''-(a-b)=(A-A')\ (t'-t) \quad (8)$$

Eliminating $(A-A')$ between (6) and (8,) there results

$$\frac{a'-b'-(a-b)}{a''-b''-(a-b)}=\frac{t'-t}{t''-t}; \quad (9)$$

which expresses the relation between the elements of any three sets of observations. Solving (9) for (t') we have

$$t'=t+\frac{t''-t}{a''-b''-(a-b)}\ [a'-b'-(a-b.)] \quad (10.)$$

Wherefore, knowing the elements of any two observations $(a,)$ $(b,)$ (t) and $(a'',)(b'',)(t'',)$ we have the temperature (t') in terms of its corresponding readings $(a',)$ $(b'.)$

It is evident that the observations $(a,)$ $(b,)$ (t) and $(a'',)$ $(b'',)$ $(t'',)$ should be made with great care, in places subject for the time to but slight variations of temperature, so that the thermometer which is used, either attached or detached, may be depended upon as indicating truly the temperature of the mercury. It is evident also, that accuracy would be materially promoted by using the means of a number of successive observations rather than individual ones; and also by choosing such temperatures that $(t''-t)$ may be as large as circumstances will permit.

An example may serve the purpose of illustrating the practical application of the formula:—to determine the numerical co-efficients of (10) for No. 366 Bunten's mountain barometer, I made the two following sets of observations.

$$a=393.575,\ b=358.760,\ t=-3.22$$
$$a''=391.746,\ b''=355.043,\ t''=+16.73.$$

Here, as throughout this paper, unless the contrary is expressed, the unit in length is a millimètre, and the degrees are those of the centigrade scale. The formula, however, is equally applicable to any other denominations. The first set is the mean of ten successive hourly observations, in which, during the whole time, the temperature was so uniform as to vary but 1°.7. In this, as in the second series, the barometer had been suspended some hours before the first observation of each series was made. The second set is the mean of seven hourly observations, during which time the attached thermometer varied only 0.6 of a degree. To remove what may seem a fallacious aspect of exactness from the number of decimal places in the readings, I would observe that the scale is graduated in millimètres, which are sub-divided into tenths by a vernier, and these, by careful reading, may be divided into halves or quarters, by the eye. The third decimal place results from the process of taking means, and depends for its exactness, upon the number of observations taken. Substituting these observed values of $(a,)$ $(b,)$ $(t,)$ $(a'',)$ $(b'',)$ $(t'',)$ in (10,) we have

$$t'=-3.22+\frac{19.950}{1.888}(a'-b'-34.815;)$$

or, after reduction, $t'=10.576\,(a'-b'-35.12)$ $(10'.)$

If, for example, the upper reading is 392.35, and the lower one 356.63, then, according to the formula, the temperature will be 6.35 degrees.

The temperatures calculated by this formula for No. 366 Bunten's barometer I found to differ very rarely so much as one degree from those indicated by the attached thermometer, and most frequently not half that, when the observations were made with suitable care in a place of comparatively uniform temperature; and the more confidence I had in the correctness of the observations, the closer the agreement seemed to be.

This formula, like all others relating to the barometer, supposes an exact instrument. It is desirable therefore to have the means of testing its accuracy of construction, and, if faulty, of applying a suitable correction.

The imperfections of a barometer may chiefly be classed under the following heads.

1. An erroneous scale.
2. An imperfect vacuum.
3. Variableness of the friction of the mercury on the interior surface of the tube.
4. The want of equality and uniformity of those parts of the two branches within the range of the mercurial surfaces.

The first of these must evidently occasion uncertain results in the calculated temperature, as well as in every other object of research, and the above formula furnishes no means of detecting or appreciating the error of the scale. An imperfect vacuum, although it influences the length of the column, and on *this* account injures the instrument, has no effect upon the calculated temperature. For, in this respect, it is evidently immaterial whether the inferior surface falls, and the superior one rises by atmospheric pressure alone, or whether it is modified by the elasticity of the enclosed air.

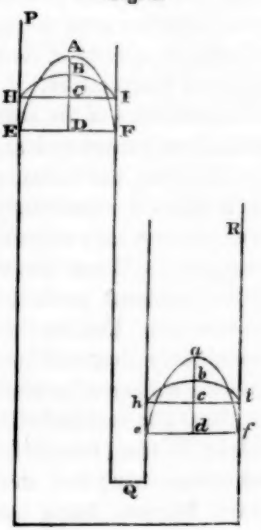
The third imperfection, although little attention has been bestowed upon it hitherto, is one to which barometers of all constructions are exposed, and is probably among the most difficnlt to rectify. The effects of this are to sustain the column at a height different from that due to the atmospheric pressure, and also to change the *forms* of its convex terminations. Both these circumstances occasion error as it respects the height of the column, while the latter, or change of form only, can affect the correctness of the calculated temperature.

The altitudes of the segments which terminate the column are found to vary more or less at different times in the same barometer. In some, the variation is quite inconsiderable, if necessary care is taken in observing; while in others, one or both the terminal surfaces may assume all forms from a plane to an apparent hemisphere. When the atmospheric pressure is increasing, the inferior meniscus tends to become less convex, and the superior one more so. For, as the column lengthens, and the mercury consequently descends in the shorter branch of the siphon, the cylindric surface of mercury which is in immediate contact with the glass tube is retarded by its friction against the glass, and retards in its turn, though in a less degree, the next concentric surface of mercury; and this the succeeding one, and so on; the central filament being least retarded of all. This would cause

the inferior meniscus to become less convex when the column is lengthening, and more convex when it is contracting. In like manner, the superior meniscus would have its convexity increasing while that of the inferior one is diminishing, and vice versa. This tendency, which in good barometers, I apprehend is small, may be chiefly, and perhaps sufficiently counteracted by causing the barometer to vibrate once or twice far enough to produce an oscillation of the column in respect to the axis of the tube, and then, after having firmly secured the instrument in a perpendicular position, by giving it a few gentle taps with the fingers. These irregularities are greatly increased in some barometers by the *variable* adhesiveness of the mercury to the sides of the tubes, at different sections of them, arising partly perhaps from the impurity of the mercury, but more probably from imperfections of the interior surfaces of the tubes. If these latter imperfections exist to any considerable extent, which may be ascertained by measuring the altitudes of the terminal convex segments of the column, the barometer is unfit for delicate purposes; not merely because the temperature is thereby rendered uncertain, but more particularly from their influence upon the height of the column. When the altitudes of these terminal segments are not so variable as to prove fatal to the instrument, it is desirable to apply a suitable correction to the formula for temperature.

For this purpose let **PQR** represent the tube of a siphon barometer; **EAF**, *eaf* the *forms* of the terminal segments of the column, when the upper and lower readings are respectively (*a*,) (*b*;) **HBI**, *hbi* the *forms* and *positions* of these segments, when the readings are (*a'*,) (*b'*). If the two meniscuses of the longer branch are similar, and also the two meniscuses of the shorter one, it is evident that (*a'*) and (*b'*) would require no correction; since the correction for (*a'*,) for example, is obviously **AB**, the height to which the vertex **B** of the meniscus **HBI** must rise if this meniscus should assume the form of that of **EAF**, without dis-

Fig. 2.



placing the body of the column below it. Suppose then the parts of the column in the vicinity of the circle HI to have such a horizontal tendency towards the axis of the tube, without disturbing the column below, as to cause the meniscus HBI to take the form of EAF. We shall then have this equation:

Meniscus EAF = meniscus HBI + cylinder HEFI. (11.)

Put height AD of meniscus EAF = H.

Height BC of meniscus HBI = H′.

Radius of tube ED = r.

Correction AB = x.

Height of cylinder CD = y.

Circumference of a circle whose diameter is unity = π.

And let the capacity of any meniscus EAF be represented by (πr^2) multiplied by a function F (H) of its height. Equation (11) therefore becomes $\pi r^2 . F(H) = \pi r^2 . F(H') + \pi r^2 y$.

From the figure we have $H = H' + y + x$.

Dividing the first of these equations by $(\pi r^2,)$ and eliminating $(y,)$ we have $x = H - H' + F(H') - F(H.)$ (12.)

It remains only to determine F (H,) F (H′,) which depend upon the form of the meniscus.

If the tube is small, the meniscus differs insensibly from the segment of a sphere, (Mécanique Céleste, 9334.) And generally, since the meniscus in barometer tubes is a small portion of the solid of revolution of which it is a segment, every practical purpose would be answered by considering it a common paraboloid. This being so, we have $F(H) = \frac{1}{2}H$, and $F(H') = \frac{1}{2}H'$; and consequently (12) becomes $x = \frac{H - H'}{2}$, (13.) Wherefore (a') is corrected to $a' + \frac{H - H'}{2}$, (14.)

In like manner, denoting the corresponding heights of the meniscuses in the lower branch by $(h,)$ $(h',)$ we shall find (b') to become $b' - \frac{h - h'}{2}$, (15;) and consequently $(a' - b')$ becomes, after correction, $a' - b' + \frac{H + h}{2} - \frac{H' + h'}{2}$, (16.) Hence, to find the correction for the difference of readings $(a' - b',)$ we subtract the half sum of the heights of the meniscuses which terminate this column from the half sum of the heights of the meniscuses which terminate the column of which the readings are $(a,)$ $(b.)$

It is evident from (16) that no error will be introduced, and consequently no correction will be needed, even if the forms of the meniscuses do vary, provided the sums of their altitudes for each column are constant; that is, provided the height of the upper meniscus increases as that of the lower one diminishes, and vice versa. This indeed is the tendency in good tubes properly filled, and furnishes a convenient and useful test.

Example. I took two observations with No. 365 Bunten's barometer, in which the altitudes of the meniscuses were particularly subject to variation. The elements of the first observation were

$a=407.75$, $b=363.11$, $H=1.68$, $h=1.75$; and of the second $a'=400.11$, $b'=360.09$, $H'=0.90$, $h'=1.60$.

According to (16) therefore, the corrected difference of readings is 40.49; while the observed difference is 40.02.

We have hitherto supposed the tubes, within the ranges of the mercurial surfaces, to be of equal and constant diameters. It is desirable to test the accuracy of the instrument in this respect, and, if necessary, to apply the suitable correction for temperature. A correction also for capillarity is equally important, and may be directly applied by knowing the diameter of the tube at the extremity of the column.

We will suppose the tubes within the ranges of the mercurial surfaces to be frustums of cones; and, besides the notation and figure employed in determining (9,)

Put R=radius of the tube at D,

r=radius of the tube at d,

θ=angle which the axis of the tube makes with its side at D,

θ'=angle which the axis of the tube makes with its side at d;

and suppose the cylinders, whose altitudes are $(p,)$ $(p',)$ to rest on bases at D, d, respectively equal to the horizontal sections of the barometric tube at these points.

Regarding the tubes DD', dd', from the necessary smallness of their heights, as cylinders, we have

Capacity of the tube $DD'=\pi R^2 p(t'-t,)$ (17.)

Capacity of the tube $dd'=\pi r^2 p'(t'-t,)$ (18.)

Radius at $D''=R+(a,-a)\sin.\theta$.

Radius at $d''=r+(b,-b)\sin.\theta'$.

Frustum $DD''=\frac{\pi}{3}(a,-a)\,[R^2+[R+(a,-a)\sin.\theta]^2+R[R+(a,-a)\sin.\theta]^2,]$ (19.)

Frustum $dd''=\frac{\pi}{3}(b_{,}-b)\,[r^2+[r+(b_{,}-b)\sin.\,\theta']^2+r[r+(b_{,}-b)\sin.\,\theta']^2]$ (20.)

It is evident, whatever may be the forms of the tubes, that

capacity of $D'D''$ = capacity of $d'd''$ (21.)

But, from the figure cap. $D'D''$ = cap. DD'' − cap. DD'

cap. $d'd''$ = cap. dd'' + cap. dd'.

Equating the second members according to (21,) and transposing, we have

cap. DD'' − cap. dd'' = cap. DD' + cap. dd';

or, denoting the sum of the second members of (17) and (18) by (I,) (22)

the second member of (19) by ($K_{,}$) (23)

and the second member of (20) by ($L_{,}$) (24)

we have $K-L=I$ (25.)

In like manner, if the observations $(a_{,,}, b_{,,}, t_{,,})$ $(a_3, b_3, t_3,)$ $(a_4, b_4, t_4,)$ be compared respectively as above with $(a, b, t,)$ we shall have $K'-L'=I'$, $K''-L''=I''$, $K'''-L'''=I'''$; (26) the terms of these equations being functions similar to those of (25.)

The four equations (25) and (26,) after correcting the readings, are sufficient to determine the unknown quantities $\frac{R^2}{r^2}$, θ, θ' and $\left(\frac{R^3}{r^2}p+p'\right)$ which these equations contain.

From the minuteness of the angles $(\theta,)$ $(\theta',)$ we may use $(\theta,)$ (θ') in the places of sin. θ, sin. θ'; and neglect the terms which contain the second powers of these angles. This will materially abridge labor without impairing the practical accuracy.

As our limits will not permit us to discuss the general question, we will select that particular case only in which the two branches are *cylinders* of unequal diameters; and which is the most important, if not the only one that needs to be regarded in the use of the barometer.

Here $\theta=0$, $\theta'=0$

$K=\pi R^2(a_{,}-a)$ according to (23)

$L=\pi r^2(b_{,}-b)$ " (24)

$I=\pi\varepsilon(R^2p+r^2p')$ " (22)

Substituting these in (25,) and dividing by $(\pi r^2,)$ we have

$$\frac{R^2}{r^2}(a_{,}-a)-(b_{,}-b)=\varepsilon\left(\frac{R^2}{r^2}p+p'\right)\ (t'-t,)\ (27.)$$

In like manner, if we compare the elements $(a_{,,}\ b_{,,}\ t_{,,})$ $(a_{,,,}\ b_{,,,}\ t_{,,,})$ with $(a,\ b,\ t,)$ successively, we shall have

$$\frac{R^2}{r^2}(a_{,,}-a)-(b_{,,}-b)=\varepsilon\left(\frac{R^2}{r^2}p+p'\right)(t''-t,) \quad (28)$$

$$\frac{R^2}{r^2}(a_{,,,}-a)-(b_{,,,}-b)=\varepsilon\left(\frac{R^2}{r^2}p+p'\right)(t'''-t,) \quad (29)$$

Eliminating $\varepsilon\left(\frac{R^2}{r^2}p+p'\right)$ from the last three equations, we shall have

$$\frac{\frac{R^2}{r^2}(a_{,}-a)-(b_{,}-b)}{\frac{R^2}{r^2}(a_{,,}-a)-(b_{,,}-b)}=\frac{t'-t}{t''-t} \quad (30.)$$

$$\frac{\frac{R^2}{r^2}(a_{,,}-a)-(b_{,,}-b)}{\frac{R^2}{r^2}(a_{,,,}-a)-(b_{,,,}-b)}=\frac{t''-t}{t'''-t} \quad (31.)$$

Solving (31) for $\left(\frac{R^2}{r^2}\right)$ we have

$$\frac{R^2}{r^2}=\frac{(t''-t)\,(b_{,,}-b)-(t''-t)\,b_{,,,}-b)}{(t'''-t)\,a_{,,}-a)-(t''-t)\,(a_{,,,}-a)} \quad (32.)$$

The readings in (30) and (32) are those of the supposed inexpansible scale. To change these equations into terms of the readings taken from the brass scale, after being corrected for the height of the meniscuses, we have

from (3′) $\left.\begin{aligned} a_{,} &= a' +\varepsilon'(t' -t)(a' +f)\\ a_{,,} &= a'' +\varepsilon'(t'' -t)(a'' +f)\\ a_{,,,} &= a''' +\varepsilon'(t''' -t)(a''' +f)\end{aligned}\right\}$

and from (3″) $\left.\begin{aligned} b_{,} &= b' +\varepsilon'(t' -t)(b' -f)\\ b_{,,} &= b'' +\varepsilon'(t'' -t)(b'' -f)\\ b_{,,,} &= b''' +\varepsilon'(t''' -t)(b''' -f)\end{aligned}\right\}$ (33)

Substituting in (32,) and reducing, we have

$$\frac{R^2}{r^2}=\frac{b''-b+\varepsilon'(t''-t)\,(b''-b''')-\frac{t''-t}{t'''-t}(b'''-b)}{a''-a+\varepsilon'(t''-t)\,(a''-a''')-\frac{t''-t}{t'''-t}(a'''-a)} \quad (34)$$

Neglecting the third terms in the numerator and denominator, as they are nearly equal and very small, we have

$$\frac{R^2}{r^2}=\frac{b''-b-\frac{t''-t}{t'''-t}(b'''-b)}{a''-a-\frac{t''-t}{t'''-t}(a'''-a)}; \quad (35)$$

which is the same as (32).

In like manner, substituting in (31,) and resolving for $(t'-t)$, we have

$$t'=t+\frac{(t''-t)\left[a'-a-\frac{r^2}{R^2}(b'-b)\right]}{a''-a-\frac{r^2}{R^2}(b''-b)+(t''-t)e'\left[a''-a'-\frac{r^2}{R^2}(b''-b')\right]} \quad (36.)$$

Neglecting the fourth term in the denominator from its minuteness, we have

$$t'=t+\frac{t''-t}{a''-a-\frac{r^2}{R^2}(b''-b)}\left[a'-a-\frac{r^2}{R^2}(b'-b)\right]. \quad (37)$$

In these last four equations $(a',)$ $(a'',)$ $(b',)(b'',)$ are the readings after being corrected, if necessary, for the heights of the meniscuses. These formulæ are sufficient for determining the relative diameters of the two branches of the siphon, and the mean temperature throughout the mercurial column.

An example will serve to illustrate the process.

To test No. 366 Bunten's mountain barometer, and to deduce the formula for the temperature of the mercurial column, I made the following observations.

	Upper reading.	Lower reading.	Heights of upper meniscuses.	Heights of lower meniscuses.	Temperature of mercury.
1	a =400.71	b =365.04	H =1.73	h =1.48	t = 6.20
2	a' =a'	b' =b'	H′ =H′	h' =h'	
3	a'' =394.64	b'' =356.50	H″ =1.80	h'' =1.69	t'' =31.32
4	a''' =389.60	b''' =352.43	H‴ =1.77	h''' =1.64	t''' =21.40

The second observation is any one of which the temperature is demanded. The remaining three were taken agreeably to the suggestions under (10.) And it is farther important in this case, that at least two of the upper readings should differ considerably from each other in value; which may be effected by observing at the base, and on the summit of a hill, or under different atmospheric pressures at the same place. In this example, however, owing to the accidental loss of the barometer, the difference between any two upper readings, is not so great as it ought to be.

By (14) and (15)

a' is corrected to $a'+\frac{1.73-H'}{2}$; b' is corrected to $b'-\frac{1.48-h'}{2}$.

a'' " 394.60; b'' " 356.60.

a''' " 389.58; b''' " 352.51.

The left readings are those found in the formula, which are supposed to have been corrected for the heights of the meniscuses. The readings found in their equivalents, are those taken from the brass scale. Substituting the observed temperature and corrected readings in (35,) we have $\frac{r^2}{R^2}=1.0013$; so that the diameter of the longer branch being denoted by unity, that of the shorter branch would be 1.0006.

For the temperature, we have, after the necessary substitutions and reductions

$$t'=10.74(a'-1.0013\,b'-\frac{H'+h'}{2}-33.02). \quad (38.)$$

In which $(a',)$ $(b',)$ are the observed readings, and H', h', the height of the meniscuses.

This formula is easy of application, although it provides for imperfections in the instrument, which are not necessary to it, and which may in a great measure, or perhaps entirely, be avoided by ingenuity and care in the construction.

Remarks.—If the tubes of the two branches are cylinders of equal diameters, and their interior surfaces are free from tarnish, or any foreign substance, such as dust, humidity, &c., and are filled with pure mercury, according to the well known rules for this process, the heights of the meniscuses, I am confident, would not vary in such a manner as to require a correction in the formula for temperature. If barometers were thus constructed, with that care which all exact instruments demand, the temperature could be derived from a formula like (10′) in but little more time than would be requisite to read it *accurately* from a thermometer, and record it; and what is still more important, the height of the column would not be subject to those errors which a construction faulty in these respects must occasion.

The means above set forth for determining the mean temperature of the mercury, throughout the whole extent of the column, and for detecting and correcting the defects of the instrument, are *peculiar* to siphon barometers, and give this form a decided advantage over all others.

These formulas may be used, not only to determine the temperature of the mercury, but, supposing this to have been ascertained by any other means, to verify the correctness of the observations; as for example, the correctness of the readings and temperature $(a',)$ $(b',)$ $(t',)$ would be verified by their satisfying equation (38.)

If, in any case, doubt should be entertained as to the parabolic form of the meniscus which in (12,) makes $F(H)=\frac{1}{2}H$, we can put $F(H)=BH$; B being an indeterminate co-efficient. Then as from (12) to (16,) $a'-b'$ would be changed to $a'-b'+B(H+h-H'-h')$; and from equation (10) we should have

$$a'-b'-(a-b)+B(H+h-H'-h')=(A-A')(t'-t,)$$

$$a''-b''-(a-b)+B(H+h-H,-h,)=(A-A')(t''-t);$$ H, and $h,$ being the altitudes of the meniscuses for a'', b''.

These two equations give the numerical value of B—. To determine the form of the meniscus from this value of B, we have, regarding its vertex as the origin of coordinates, $\int \pi y^2 dx = \pi B y^2 x$. Differentiating, &c. $\frac{1-B}{2B} \cdot \frac{dx}{x} = \frac{dy}{y}$. Integrating and returning to numbers, we have

$cx=y^{\frac{2B}{1-B}}$; in which (C) is the correction. This is a parabola, if $\frac{2B}{1-B}$ is positive, which becomes the common one, when $B=\frac{1}{2}$. If $\frac{2B}{1-B}$ is negative, it is an hyperbola; which is the common one, if $B=-1$. But the hyperbolic form, it is evident, cannot subsist in a mercurial barometer. Various consequences from the above formulæ, and remarks relating to the construction of the barometer, and the necessary precautions to be taken in observing, my limits compel me to omit.

ART. IV.—*Catalogue of the Mollusca of Middlebury, Vt., and vicinity, with observations;* by C. B. ADAMS, Prof. Chem. and Nat. Hist. Middlebury College, Memb. Bost. Soc. Nat. Hist.

THE utility of catalogues of species, which inhabit distant parts of this country, as materials for ascertaining their geographical distribution, need not be urged. Even a single local catalogue cannot but be of interest and utility. It is obviously important that the stations and the abundance or scarcity of the several species should be designated. Such catalogues should also be drawn up by those whose residence in the region enables them to make numerous observations at all seasons, to detect the rare species and those which appear only for a very limited time during the year.

In obtaining materials for the following catalogue, my acknowledgments are due to Prof. George W. Benedict, of Burlington; also to Messrs. K. Prescott, Luther H. Sheldon, and M. W. Johnson, who have been my assistants in the department of Natural History, and who have detected some of the rare species, which might otherwise have escaped search. That other species may yet be found is by no means improbable, for a species, whose habitat should be as circumscribed as that of *Vitrina pellucida, Drap.*, (see following remarks,) appears to be in this vicinity, may elude the researches of many years. But after the careful search, which has been made in various places and in every station, especially by my assistants, it cannot be expected that any important additions will be made.

MELANIA.

M. depygis, Say. It is remarkable that no species of the family *Melaniana* occur in the New England States, with this single exception, although some are abundant in New York. This species occurs here only in Lake Champlain, where it was first found by my friend Prof. George W. Benedict, in Burlington. It is very rare. I have found several imperfect specimens, and but one with the animal, at Shoreham.

PALUDINA.

P. decisa, Say. This species, so common in the streams and ponds of New England, occurs plentifully in Otter Creek, but

rarely in Lake Champlain. Deshayes could not have suggested, as he has, (2d edit. Lam. An. sans Vert. in loc.) that this is the young of *P. ponderosa, Say*, had he seen suites of young and old in both species. This species is more nearly related to *P. integra, Say*, from which it is well distinguished by Haldeman, (Monog. Limniad. No. 1.)

P. lustrica, Say. This species is very abundant in Lake Champlain and in the streams. Its color varies from brown to green in different localities.

VALVATA.

V. tricarinata, Say. Abundant in Lake Champlain, of a grass green color.

V. sincera, Say. This species occurs plentifully in Putts's swamp, on the New York side of Lake Champlain, opposite Bridport. It is so rare, that a description of the animal may not be without interest.

Foot whitish, swelling and regularly rounded posteriorly, with the anterior lobes sharply angular, somewhat contracted in the middle, less than .3 in. long; *head* anteriorly obtuse and bilobed, —lobes regularly rounded,—whitish, with a tinge of slate color on the top, deepening posteriorly; *mouth* pale-yellowish; *tentacles* filiform, whitish, more than .2 in. long; *eyes* minute, black, shining, situated on the upper and outer part of the posterior side of the protuberance at the base of the tentacles; *branchial cavity* blackish brown on the margin; *plumose branchia* consisting of a stem, on each side of which extend, at right angles to it, about ten filiform obtuse branches, bent in zigzag, shorter near the top, the whole appearing like a feather; *tentaculiform branchia* rather longer than the tentacles, equally slender and obtuse.

LIMNÆA.

L. megasoma, Say. This large and rare species I have seen only at Burlington.

L. appressa, Say. This species has been found only in or near Lake Champlain. At Burlington it is common. Sometimes it is nearly as much shouldered on the body whorl as the *L. stagnalis* of Europe, from which it differs very slightly.

L. gracilis, Jay. This very remarkable species occurs in Lake Champlain. About half a dozen specimens were discovered near Burlington, and have been distributed by Prof. Benedict. A single specimen, large and perfect, but without the animal, I found

in Addison. The most striking character of this species is its elongation with a very few whorls. The specimen in my cabinet is one inch in length, and in the convexity of the penult whorl only .15 in. diameter. The last whorl is scarcely broader, except across the lips, both of which are expanded. Although nearly seven times longer than its average breadth, it has only $4\frac{1}{2}$ whorls!

L. pallida, nob. This species has been found only at Shoreham. Since it was described, I have found three living specimens, of a dingy white!

L. elodes, Say. This species is not very common.

L. umbrosa, (?) Say. A Limnæa is very abundant in many parts of the New England States, which corresponds very nearly to Say's *umbrosa*. Some specimens, however, have a more prominent columellar fold than is ascribed to that species, and Dr. Gould (Mss.) has proposed for it the name *L. plebeia*. The prominence of this fold is subject to variation, and is not sufficiently marked to constitute alone a good specific character.

L. desidiosa, Say. This species is very common, and is subject to great variation of form, sometimes being elongated and scarcely to be distinguished from *L. elodes*. Other specimens are short, as in Say's fig. (Am. Conch.) and the upper part of the last whorl is much inflated and more or less shouldered, while the lower part is produced. This variety approaches *L. umbilicata, nob.*, which, however, has the umbilicus larger, and the lower part of the last whorl abbreviated, much inflated, and globular, so that the whole shell has the form of a cone with a hemispherical base.

L. caperata, Say. Although common in this vicinity, this species has not been found elsewhere in the eastern states.

PHYSA.

P. ancillaria, Say. This rare species occurs in Lake Champlain, and in some ponds in Sudbury. In the lake it is remarkable for being sometimes of a deep bay color. The young are not easily distinguished from the next species, although mature specimens differ widely.

P. heterostropha, Say. This species is common here as in many other parts of New England.

P. gyrina? Say. Of this species a very few specimens only have been found. Although I have not seen authenticated specimens, nor any figure, of Say's species, they correspond so well

with his description, that I have not much hesitation in referring them to it.

P. elongata, Say. This species is rather common here. It is rarely seen in Mass., but has been found in New Bedford by my friend C. F. Shiverick, Esq.

The above four species of Physa differ chiefly in the proportions of the spire and aperture, and of the length and breadth, the gradation in these two particulars being parallel, as appears in the following table. The ratio is, of course, subject to some variation, even in mature specimens, which alone should be compared.

	Length.	Breadth.	Ratio.	Length of spire.	of aperture.	Ratio.
P. ancillaria,	.65 in. :	.48 in.	=1.35.	.1 in. :	.55 in.	=.18.
P. heterostropha,	.75 in. :	.45 in.	=1.67.	.25 in. :	.5 in.	=.5.
P. gyrina?	.55 in. :	.25 in.	=2.2.	.23 in. :	.33 in.	=.7.
P. elongata,	.58 in. :	.25 in.	=2.32.	.28 in. :	.30 in.	=.93.

Planorbis.

P. lentus, Say, and *P. corpulentus, Say.* These are undoubtedly varieties of the same species, the former being merely a stunted growth of the latter. Very large and beautiful specimens were found plentifully below the falls of Otter Creek, in this village, during the spring of 1839, but last year not one could be found. Some were 1.15 in. in their greatest breadth, and .55 in. in the height of the aperture. This species is common in Lake Champlain.

P. campanulatus, Say. I have found this species only in the Lemonfare river, where it was abundant.

P. bicarinatus, Say. Common.

P. armigerus, Say. Common in swamps. In the dry season it takes refuge among the moist and decaying leaves.

P. exacuous, [exacutus?] Say. This species is the most depressed and fragile of all our Planorbes. A specimen .24 in. in diameter is only .05 in. in height, and weighs only .05 of a grain. It is found clinging to wood, in still water, on the margins of Lakes George and Champlain, but is not plenty. My friend, J. W. Mighels, M. D., of Portland, has found it rather plentifully in the interior of Maine. In the eastern part of Massachusetts it has been found in several places.

P. parvus, Say. This species is common. One specimen in my cabinet is $\frac{1}{4}$ in. in diameter.

P. elevatus, nob. This species does not differ much from some varieties of the preceding, and perhaps may not prove entitled to rank as a species. All the specimens which I have seen, however, present that *constancy* of difference which is most important in distinguishing species. One or two specimens have been found in a swamp at Ticonderoga, N. Y.

P. hirsutus, Gould. This species, common in the vicinity of Boston, is rare in this region. It is found in company with *P. exacutus.*

P. deflectus, Say. A very few specimens have been found, in company with *Valvata sincera.*

SUCCINEA.

S. obliqua, Say. This species is frequently confounded, as perhaps it should be, with *S. campestris, Say.* In the Western States this shell is of a pale horn color, but in this vicinity it is of a deep shade of amber. It is common in low grounds under stones and wood. On the Brothers' Islands, opposite Burlington, Prof. Benedict has found very large specimens, one of which in my cabinet is .97 in. long, and .55 in. wide. The animal is more or less thickly mottled with dark purple. In October a thin transparent epiphragm is formed.

S. ovalis, Say. This very fragile species is found only very near water. In low ground, which is covered with a species of flag, and overflowed by Lake Champlain in the early part of summer, I have seen them in immense numbers on the upper part of the flags. *S. putris* of Europe is intermediate in form between this and the preceding species.

S. avara, Say. This species is the young of *S. vermeta, Say.* At this age a viscid substance attaches dirt to the shell, which becomes clean in a mature state. As the young was first described, the name of the adult must be rejected. This species is found in the same station with *S. obliqua,* and in this region is rather rare.

BULIMUS.

B. lubricus, Drap. This species is remarkable for its extensive geographical distribution, being dispersed over a large part of Europe. It is rather common in this vicinity, has been found in great abundance near Boston by Dr. Gould, and was seen near Lake Winnipeck and the Lake of the Woods by Say. With equal propriety the species has been referred to Achatina, but as

Deshayes remarks, (Lam. An. sans. Vert. 2nd edit.,) in common with some others, it establishes a passage between the two genera, and proves the uselessness of one of them.

PUPA.

P. armifera, Say. Of this species, not before known this side the Alleghany Mountains, (Gould, Monog. Bost. Journ. Nat. Hist. Vol. III, p. 401,) I have found a very few specimens in Bridport on the borders of Lake Champlain, and Prof. Benedict has found it at Crown Point.

P. badia, nob. This species was discovered in company with the preceding by Prof. Benedict. Dr. Gould (op. cit.) remarks that it is "almost precisely like" *P. marginata, Drap.* That species has a narrower aperture and wider umbilicus. It is quite possible however that a comparison of numerous specimens may establish their specific identity.

P. albilabris, Ward's letter. This species is well known as Say's *Cyclostoma marginata.* The late lamented Dr. Ward, of Roscoe, Ohio, ascertained that it was a Pupa, and, as Say's specific name had been pre-occupied in this genus, proposed for it the name which we have given. A few specimens only in this region have been found by Prof. Benedict.

P. ovata—syn. *Vertigo ovata, Say.* This species has been mistaken by some for *P. modesta, Say,* but a specimen with all the teeth fully developed leaves no doubt in my view of the correctness of others, who have regarded it as *P. ovata.* It is rare in this vicinity, but is more common near Boston.

P. contracta, Say. This species is found quite plentifully. Mature specimens vary considerably in size.

P. exigua, Say. This very neat little species is rather common.

P. milium, Gould. This is the most minute shell, which has been described in this country. Twelve mature specimens together weighed less than .06 gr., or .005 gr. each. The *Delphinula serpuloides, nob.*, the least of the marine shells of New England, weighs precisely twice as much. The dimensions of *Pupa milium* are, length .06 in., breadth .03 in. The *Helix pygmæa, Drap.*, according to Turton, (Land and Fresh Water Shells of Great Britain,) is .05 in. broad, and Deshayes remarks (op. cit.) that it is "une des plus petites espèces connues." This Pupa therefore is probably the most minute of known shells, with the exception of the microscopic Cephalopods.

This species was not "first discovered" by Dr. Gould, as claimed by him, (op. cit.,) but was discovered in July, 1839, by Mr. Sheldon. I supposed, until the publication of Dr. G.'s description, that it had long been known to him, and the privilege of describing it was tacitly yielded to his claim of discovery.

HELIX.

H. albolabris, Say. This species is every where found, but is most abundant in company with *Succinea obliqua, Say,* at the Brothers' Islands, and in the same company on an island near the N. E. extremity of Lake George. A pink variety is rare. This species sometimes attains a size of 1.35 in. in its greatest diameter; but another mature specimen, from a different locality, is only .9 in. in its longest dimension. A specimen from Cincinnati, which I received from my friend J. G. Anthony, Esq., very nearly approaches in size to *H. major, Binney,* being 1.4 in. broad.

H. thyroidus, Say. Only three or four specimens of this species have been found in this vicinity. They had a tinge of pink.

H. palliata, Say. This species is as rare here as the preceding.

H. monodon, Rack. and *H. fraterna, Say.* These species are common on hill sides. In some specimens now before me the umbilicus is entirely covered by the reflected lip, which is characteristic of the *fraterna;* but others have it scarcely encroached upon by the lip, and are therefore the *monodon.* As the very numerous specimens, which I have collected, present every intermediate condition, as well as also in respect of size and elevation of the spire, and especially as their gradations in these particulars are by no means parallel, I have not been able to find two species among them. With such authorities, however, as Say and Binney, for their specific difference, I cannot but distrust the correctness of my conclusion.

H. concava, Say. This species is rare in this vicinity.

H. pulchella, Müll. This species is very abundant in this town, so that I have taken eleven hundred specimens in one hour. The shell is stouter than in many other parts of the country. The species is remarkable for its very extensive geographical distribution. It is well known as a native of Great Britain and of a large part of Europe. In this country, it has been found in Maine by Dr. J. W. Mighels, of Portland, and was seen by Say as far west as Council Bluffs, on the Missouri river; from Prof.

Foreman, of Baltimore, I have received specimens collected at Charleston, S. C. At many intermediate places it has been found by numerous observers.

H. Sayii, Binney. This species is very rare here, only one good specimen, and a few partially decayed, having been found.

H. tridentata, Say. This species is not common in this region. Its size is less than that of specimens from the western states.

H. labyrinthica, Say. This singular little species is not rare.

H. indentata, Say. This species is rare. The animal is remarkable for being of a rather light blue color.

H. arborea, Say. This species is very common. It inhabits both dry and wet lands. In the former situation the shell is of a pale horn color; in the latter it is of a deep brown, and the animal is black. The latter variety attains a greater size, some specimens in my cabinet being .3 in. broad.

H. inornata, Say. One specimen only has been obtained here. With this exception, I believe this species has not been found in New England.

H. alternata, Say. This species is very common. At the Brothers' Islands, it attains its greatest size, some specimens being one inch in diameter.

H. chersina, Say. In April, 1839, this species was found in this town. Not long after it was found near Boston. It is not rare.

H. lineata, Say. This species is not rare. It is of a beautiful light green, and is remarkable for its resemblance to a Planorbis.

H. striatella, Anth. This species, long confounded with *H. perspectiva, Say,* which does not occur in New England, was first recognized as a distinct species by J. G. Anthony, Esq. In this species the last whorl much exceeds the umbilicus in diameter, while in Say's shell it is not more than equal to it. The last whorl in the former is also much larger. Less essential differences are that Say's species is larger, uusally of a darker color, and that it has the striæ more elevated. The *striatella* is quite common here.

H. fuliginosa, Griffith, is rare in this part of Vermont.

H. electrina, Gould, in Binney's Monog. This species was discovered by me in Marion Co., Mo., in Nov. 1837. In August, following, Col. A. Bourne, of Chillicothe, Ohio, forwarded to me specimens from that place. Subsequently I have found it in this town and at Rogers's Rock, Lake George, and Dr. Gould has

found it near Boston. It is not rare here, and is associated with *H. arborea*, under logs, &c., both in moist and in dry lands. Dr. Gould has found it only near the water's edge.

This species is remarkable for its close resemblance above to *H. indentata, Say*, and beneath to *H. arborea, Say*. This resemblance is so striking, that a view of either side alone would lead any one to place it with one or the other of these species. A comparison of both sides easily distinguishes it.*

H. multidentata, Binney. This beautiful little species was discovered by Dr. Binney several years since, in Strafford, Vt. Subsequently it has been found in this town very sparingly. It is remarkable for the roseate color of the animal, seen through the semi-transparent shell, and for the *teeth*. These are placed in rows, far within the aperture, on its outer and lower half. The rows are curved, with the convexity towards the aperture, and contain four to six closely approximate teeth, appearing through the shell like glass beads. The number of rows varies from two to four, of which never more than one is visible from the aperture.

H. minuscula, Binney. This species, recently discovered in Ohio, has also been found in this town. Under a log, in wet land, I found a large number, but have not found many elsewhere. It exactly resembles *H. pulchella, Müll.*, in size and color, but that species is easily distinguished by its reflected lip, enlargement of the last whorl, and small umbilicus.

Vitrina.

V. pellucida, Drap. This species was observed first on this continent by Say, who remarks that it "was first found near Coldwater lake, in lat. 48¾° N., under stones, fallen timber, &c. It afterwards occurred, in similar situations, until we approached Lake Superior, when it was no more seen. No species of this genus has been hitherto found in this country; this shell is therefore the more interesting. The specimens which we collected do not appear to differ in any respect from those of Europe."† I

* A description of this species, under the name of *H. Janus*, had been prepared for this article, when I received, through the kindness of Dr. Binney, the remainder of his excellent monograph, printed in anticipation of the next No. of the Bost. Jour. Nat. Hist., in which, not aware that any one had discovered it prior to Dr. Gould, he has quoted from Dr. G.'s MSS. The two following species are described by Dr. B. in the same paper.

† App. Long's Exped. to Source of St. Pet. River.

am not aware that it has since been found, until the summer of 1839, when on an excursion to Rogers' Rock, near the N. E. extremity of Lake George, N. Y., I found a number of individuals crawling among moist leaves. On a visit to the same place, last autumn, a very few only were found. These specimens were obtained in a niche in the rock, accessible only by water, within the space of less than a square rod. A careful search in the neighborhood enabled me to detect only one dead specimen, at a distance of ten rods from the little colony.

Although I have not seen specimens of the European shell, I do not doubt that this is the same species, which is figured and described by numerous authors. It differs only in being entirely destitute of the tinge of green, which is mentioned by some of them. It is perfectly hyaline, and for elegance of contour and delicacy of aspect, cannot be surpassed.

ANCYLUS.

A. parallelus, Hald., Mss. This species has been supposed to be Say's *A. rivularis*, with the brief description of which it agrees very well. But my friend S. S. Haldeman, Esq. informs me that it is distinct. It is rather common in Otter Creek, and in a pond in the east part of Brandon.

A. tardus, Say. Found rather plentifully in a brook in the east part of this town. Mr. Prescott has also found it in the southern part of this State.

Two species of naked Mollusca, of the family *Pulmonea terrestria, Cuv.*, are found in this region, which have a dense shield-like mantle, covering the whole back, the branchial orifice on the right side near the head, and the anus at the posterior extremity. As the latter orifice does not communicate with the branchial cavity, which is immediately behind the head, these species cannot belong to the genus VAGINULUS, *Fer.*, to which I had at first referred them on account of the extent of the shield-like mantle. Not having the means here of ascertaining whether any genus has been described for their reception, I am obliged to leave them. One species is (after being preserved in spirit) $1\frac{3}{4}$ inches long and $\frac{1}{2}$ inch in diameter. The mantle is thickly mottled with a grayish black, and the spots on the back are sometimes confluent. The other species (also in spirit) is about $\frac{1}{2}$ inch long and $\frac{1}{4}$ inch in diameter, and is of a nearly uniform blackish gray color. This

species is quite common. A species of LIMAX also occurs of the same size.

ANODONTA.

A. Benedictensis, Lea. This species occurs only in Lake Champlain, where it is abundant.

A. cataracta, Say. At Wallingford, Vt., a very few specimens have been obtained.

Two other species of Anodonta occur, which I have not been able to identify with any species known to me. One of them resembles *A. Wardiana, Lea.*

ALASMODONTA.

A. arcuata, Barnes. That this species is quite distinct from the *margaritifera* of Europe, I have had an opportunity of seeing from a specimen of the latter in the cabinet of Dr. Gould. Barnes's species occurs in Onion river, at Burlington.

A. rugosa, Barnes. This species occurs in Otter Creek and Lake Champlain, but is not common.

A. undulata, Say. This species occurs in Otter Creek.

UNIO.

U. alatus, Say. Abundant in Lake Champlain.

U. gracilis, Barnes. Common in Lake Champlain.

U. compressus, Lea. This species occurs, well characterized, in a rivulet a few miles west of this village. In the east part of this town are specimens which differ so much from the common type as perhaps to constitute a new species.

U. rectus, Lam. This species occurs rarely in Lake Champlain.

U. ventricosus, Barnes. This species is rather common in Lake Champlain. It is subject to great variations of form.

U. luteolus, Lam. This species is very abundant in Lake Champlain. Its variations in form, although less than in the preceding, are considerable. In both, however, the most marked are those of sex.

U. complanatus, Lea. Very abundant in Lake Champlain and elsewhere, but I have not seen one with a white nacre. *Rayed specimens are sometimes seen.*

I have found in Lake Champlain a single specimen of another species, which is unknown to me.

CYCLAS.

C. elegans, nob. Rather common in a swamp five miles north of this village. One specimen occurred at Burlington.

C. rhomboida, Say. Very abundant in Lake Champlain. This is the only species which I have seen in the open waters of the lake.

C. partumeia, Say. Common in swamps.

C. calyculata, Drap. In company with *Valvata sincera*, this species was found quite plenty. It has also been found in this town very numerous in a cavity one yard in diameter in a swamp, and it is remarkable that not one could be found elsewhere. Dr. Mighels has found it occurring plentifully in Maine. That the same species of Cyclas should occur so abundantly in this country and in Europe, may seem incredible. But the coincidence is so exact, that were specimens from both continents mingled, I do not think that they could be separated.

The descriptions of native species of this genus are so unsatisfactory, that I do not venture to affix names to two other species, of which one is the largest and the other the least of American species.

General Remarks.—Of the thirty two terrestrial species enumerated above, three certainly, and possibly four, are also widely distributed in Europe; while of the forty five aquatic species, identity with those of Europe appears only in a single instance.

Lake Champlain appears to be the most eastern limit on this continent of the entire family of *Melaniana*, and is also on the boundary between two provinces of the Naiades. *Unio alatus*, *U. gracilis*, *U. rectus*, *U. ventricosus*, and *U. luteolus*, which are common through the western states, occur in its waters, and with the exception of *U. rectus*, plentifully, but are not found any farther eastward. *U. compressus*, and *Alasmodonta rugosa*, western species, also occur in its vicinity, but have not been found east of the Green Mountains. *U. complanatus*, an eastern species, common as far at least as Eastport, Maine,* occurs abundantly in Lake Champlain. The family of Limnæana do not observe this boundary.†

* Whence I have specimens, through the kindness of J. Ray, M. D. of that place.

† Of most of the species enumerated in this article, I have duplicates, and also of upwards of 100 marine species of the shells of Maine and Massachusetts, which I shall be happy to exchange for native or foreign shells.

ART. V.—*On the Means of detecting Arsenic in the Animal Body, and of counteracting its Effects;* by J. LAWRENCE SMITH, M. D., of Charleston, S. C.

Messrs. Editors—This, I hope, will receive a place upon the pages of your Journal, if it be only for the importance of the subject of which it treats, although it is not improbable, in stating what I am about to do concerning the more recent experiments upon arsenious acid, that your readers will be able to find something which may be of importance to them in future investigations upon this substance. But two months have elapsed since the whole of France was agitated by one of the most interesting criminal processes upon record—it was a case of poisoning by arsenic; and the contradiction of the results of the medico-legal examinations, created an excitement which the decision of the jury augmented. Three chemical examinations were made upon different portions of the body, and at different times, to ascertain whether arsenic had been administered to the individual during life. The materials for the first were furnished immediately after death, and consisted of the fluid found in the stomach, the stomach itself, and a portion of the intestines; but the first was lost by an accident which happened to it while being experimented upon, so that the stomach and intestines alone remained. The second and third were made upon portions of the body exhumed after eight months' burial; they were the liver, heart, brain, and inner muscles of the thigh. The first and second examinations were made by several expert chemists of Tulle, without detecting the poison. The third M. Orfila was called upon to make, and he succeeded in exhibiting the metal, reduced by means of Marsh's apparatus; his success was no doubt owing to the manner in which he carbonized the animal matter, which was by the aid of nitric acid.

One cannot be surprised at the excitement that a thing of this character must have produced, and it is with much interest and benefit that I have followed up the chemical researches consequently arising, as well as the many interesting questions proposed for solution, and my object now is to mention the most important of them. Some of the questions are as follows:

1st. Does the hydrated peroxide of iron contain arsenic?

2d. Does arsenic exist normally in the animal tissues?

3d. Is not Marsh's apparatus subject to serious objections?

4th. What are the best means not only of detecting but of ascertaining the quantity of arsenic when in combination with animal matter?

5th. What are the best means of combatting the poisonous effects of arsenious acid?

To all these questions such answers will be given as have yet been furnished.

Does arsenic exist in the peroxide of iron?

This question originated from the fact that this substance had been administered in the case spoken of; and there are those who suppose that the arsenic detected belonged originally to the peroxide of iron used as an antidote.

It is well known that arsenic exists in a state of combination in many of the sulphurets of iron, from which the sulphate is obtained, and it is the latter that furnishes the peroxide either by precipitation or heat. Both forms of this oxide have been subjected to minute examination by M. Orfila, who was particularly interested in this question, and the following are his experiments with their results:

"1st. I boiled during four hours, in five capsules, four and a half ounces of hydrated peroxide of iron, taken from different apothecaries, with four ounces of distilled water, and by Marsh's apparatus no trace of arsenic could be obtained.

"2d. I then added thirty grains of pure caustic potash to the hydrated peroxide of iron in each capsule, but no trace of arsenic could be obtained.

"3d. But on treating by an ebullition of five hours an equal quantity of hydrated peroxide of iron in pure sulphuric acid, the liquid of three capsules out of the five gave arsenical taches.

"4th. Four portions of four ounces each of colcothar of commerce, (the anhydrous peroxide of iron formed by heating the sulphate,) obtained from different merchants, by ebullition for four hours in distilled water, did not give indications of the presence of arsenic.

"5th. This substance in the same quantity by ebullition during five hours with strong sulphuric acid, gave large arsenical taches with the aid of Marsh's apparatus.

"6th. Thirty grains of colcothar boiled with sulphuric acid, gave arsenical taches.

"7th. Fifteen grains of the same body, treated in the same way, gave no indications of arsenic.

"8th. A solution of sulphate of iron gave no arsenical taches with the apparatus."

M. Orfila next administered four ounces of colcothar to three dogs, tying the œsophagus to prevent vomiting. One of them was examined thirty four hours after, the second fifty, and the third sixty. The liver, spleen, heart, and kidneys of these animals, were submitted to investigation, but no trace of arsenic could be obtained. The liquid of the stomach and intestines of the first dog being separated from the colcothar, gave arsenical taches, though its urine did not indicate the presence of this metal. The intestinal liquid of the second dog gave some taches, less apparent and less numerous than that of the third, but on the contrary its urine gave strong indications of arsenic.

The conclusions to be arrived at from these experiments are, that the hydrated peroxide of iron, and the colcothar, the former of which is administered as an antidote for arsenious acid, contain arsenic in minute quantities, (though the former being no doubt as often without as with it,) but that it requires the aid of a strong acid to develope it, and also, that when these substances are administered, the arsenic that they contain is slowly absorbed, passes by the organs, and is eliminated by the urine. The organs never at any time retain sufficient arsenic to exhibit it when examined for.

This question being answered in the affirmative, would appear to throw a great obstacle in the way of pronouncing with certainty whether the arsenic found in the intestinal liquid of an individual supposed to have been poisoned, and to whom the hydrated peroxide of iron had been administered as an antidote, was due to arsenious acid or to the oxide of iron. This difficulty would not arise except the quantity found be extremely small; for the peroxide of iron, from the manner in which it is prepared, can contain but the smallest appreciable amount; and, moreover, as it has already been remarked, it is not always that we find even that. The plan that the medico-jurist should adopt, in a case of this character, would be to examine the peroxide of iron that the person had taken, should there be any of it remaining,

if not the sulphate of iron from which it was made. Again, he should lay but little stress upon the examination of the intestinal liquid, but direct his attention particularly to the organs. This, together with circumstances peculiar to each case, will explain away any doubt that might arise.

It ought to be perfectly understood, that the fact of the peroxide of iron containing a small quantity of arsenic, should be considered rather as a light to guide the chemist in his researches, than as a stumbling-block that might cause him to fall into error.

Does arsenic exist normally in the animal tissues?

This perhaps has been one of the most interesting questions ever proposed to chemists, and the investigations that it has given rise to, serve to show the almost perfection of their science, for were it supposed that the whole animal frame contained but one fiftieth of a grain of arsenic, the chemist would not despair not only of being able to detect it, but also of fixing its locality.

As it regards the bones, it has been clearly demonstrated that they contain arsenic in a minute quantity, but sufficient to place the fact beyond the smallest doubt.

Whether it exists in the muscles or not, is a question by no means settled. It is true, that with the aid of Marsh's apparatus there can be obtained from muscles digested a long while in nitric acid, taches which are of different shades, such as brilliant white, brilliant yellow, and rusty color; they are volatile and not soluble in nitric acid. Many have supposed their composition to be sulphur with an infinitely small quantity of arsenic. I think that these taches can be more easily accounted for by sulphur and phosphorus, both of which exist in the muscles, and I am sorry that there is neither time nor opportunity to examine into the truth of this supposition. Nevertheless, whether they contain arsenic or not, the taches obtained have but one characteristic belonging to that of arsenic, volatility.

The next part of this question is very important; it is whether the organs, such as the liver, spleen, heart, &c., contain normal arsenic. The reason of its importance is, that it is upon them that we should place considerable reliance, in the examination of the body of a person supposed to have been poisoned by arsenic. To this we answer, that not the smallest trace has been detected in any of them; and the answer is based, not upon the few ex-

periments of a single individual, but drawn from numerous careful researches, made by skillful chemists. What is still more convincing on this point, is, that even in some few cases, where an animal has been poisoned by arsenic, its liver will not indicate its presence.

To sum up the answer to this question in a few words—the bones do contain arsenic. No positive evidence has as yet been given to lead us to believe that the muscles contain the smallest quantity of arsenic. We have the most positive evidence that the organs do not contain the least trace of arsenic.

Is not Marsh's apparatus subject to many and serious objections?

This valuable instrument I think was discussed a year or two since, by Dr. Mitchell, of Philadelphia, but as I have never seen his article on the subject, I hope, that if this should meet his eye, he will excuse such parts of it as may be a repetition of what he then stated. Most that is about to be mentioned concerning this apparatus, belongs to the investigation of those more intimately connected with the subject than myself.

Marsh's apparatus, modified from its original and rather complex form, consists of a four or eight ounce phial, with a perforated cork and glass tube, bent at right angles, or straight, (the former is considered preferable, though in both instances the extremity must be drawn out to a capillary opening,) and furnished with a porcelain plate or saucer, and the materials for generating hydrogen—zinc, sulphuric acid and water. These three last substances in effect constitute the instrument. The first question to be decided is, whether any of them are subject to an impurity that might create an error.

As regards the zinc, that there are some instances of the zinc of commerce containing a small quantity of arsenic, is not to be denied; and that this will give rise to an impure hydrogen, when acted upon by pure sulphuric acid and water. But then, again, there is nothing more easy than to procure zinc of commerce which will generate hydrogen perfectly free from arsenic, notwithstanding there are some who say that purified zinc is not free from this metal; but it is evident that they must be mistaken, as any one may see by making the experiment, which, as it is a very simple one, it would be well to perform; and I feel confident in saying that little or no difficulty will be found in procur-

ing ordinary zinc of the necessary purity to be used in Marsh's apparatus.

Sulphuric acid may contain arsenic, when manufactured with sulphur obtained from pyrites holding that substance in combination; but a simple distillation will serve to rid it of this impurity.

After placing the zinc, sulphuric acid and water in the apparatus, replace the cork with the glass tube inserted in it, and when the hydrogen has been allowed to generate a sufficient length of time to expel the air, inflame it as it issues from the extremity of the tube; if a porcelain plate be now applied to about the middle of the flame, and no tache or spot be obtained, we have the best evidence of the purity of our materials.

Another apparent objection to the apparatus, is, that the introduction of animal matter, either solid or liquid, causes the formation of a large quantity of froth, which arrests the progress of the operation. This, however, is so easily remedied, that it need hardly be considered an objection. If the froth be not in too great quantity, it will suffice to introduce a little oil, which will serve to arrest its formation. Another method is to turn the liquid out of the phial into a funnel, with the finger placed upon the lower extremity, the froth will at once rise to the surface, and by taking away the finger the liquid will pass out perfectly free from it. Again, if care be taken to carbonize the matter before using it, this obstacle will be removed. There is still another means, and I find it to succeed very well in most instances; it is to pour the sulphuric acid destined for the formation of the hydrogen first upon the animal matter, and then pour the two upon the zinc and water; it would appear that a partial carbonization takes place. No doubt most persons will now perceive that this objection possesses no weight, and vanishes altogether before the means proposed to encounter it.

The next part of this question to be examined, is, what substances besides arsenic produce taches with this apparatus, and is there no danger of confounding them with that of arsenic? They are antimony, sulphur, phosphorus and iron. Before speaking of their distinguishing characteristics, it would be as well to say a few words concerning that produced from arsenic.

The arsenical tache is highly metallic, of a steel color, with a slight reddish tinge, and borders of a dark rusty color; but to have a proper idea of its appearance, as well as that of the others,

one should see them. It is volatile by heat, and is dissolved by cold nitric acid, which solution gives to the nitrate of silver a brick-red precipitate, the arsenate of silver.

The antimonial tache is less metallic than the former in its appearance, also blacker, and when very dense even smutty. It can be volatilized, but with great difficulty, and not before it has been as it were chased about the surface of the porcelain. It is soluble in cold nitric acid, which solution gives no red precipitate with nitric acid.

The next tache to be spoken of, is the compound one, of arsenic and antimony; at the same time mention will be made of the method adopted by M. Orfila for detecting the one or the other of these metals in it. It partakes, as might be expected, of the characters of both the metals that enter into its composition, being partially volatile, soluble in nitric acid, from which the brick-red precipitate of arsenate of silver can be obtained. M. Orfila proposes a plan of separating the constituents of this tache, and of testing each by itself. He proceeds as follows: having collected a number of the compound taches upon a porcelain plate, he dissolves them in nitric acid, which solution being poured into a capsule, is evaporated to dryness, and a residue remains composed of antimonious acid and a mixture of arsenic and arsenious acids. Upon this residue a little water is poured, and the capsule slightly heated, which enables the water to dissolve more readily the two last mentioned acids. The antimonious acid being allowed to settle, the clear liquid is decanted, and a few drops of nitrate of silver being thrown upon it, the brick-red arsenate of silver is formed, which is sometimes mixed with a considerable quantity of a yellow precipitate, the arsenite of silver. This will, however, rarely happen, if a large quantity of nitric acid has been used; for by so doing, only an extremely small quantity can remain in the state of arsenious acid, the oxidation being carried a degree higher. Nevertheless, if the entire precipitate produced by the nitrate of silver be yellow, it can have no effect in destroying the fact concerning the presence of arsenic, as it only indicates that it has met with arsenious and not arsenic acid. But to return to the substance left in the capsule:—A small quantity of muriatic acid, slightly diluted, is poured upon it, which immediately dissolves it. A current of sulphuretted hydrogen is now made to pass through this solution, when the orange-colored sul-

phuret of antimony is formed. Another process will be stated for arriving at the same end, when mention is made of a method by which I propose to separate arsenic from organic substances. The importance of studying this double tache will be evident to every reflecting mind, for it may not unfrequently happen that the physician called upon to administer to a person supposed to be laboring under the effects of arsenic, may use tartar emetic to disembarrass the stomach of the supposed poison; death taking place, an examination is made of the liquid found in the stomach and intestines, of urine, &c., by means of Marsh's apparatus, and a tache is obtained which is not easily volatilized, and which has the appearance of antimony. What then is to be done? Why, we are to proceed in our experiments as just stated, and the two metals, if both be present, are to be separated.

The tache from sulphur has all the characteristics of that substance; color yellow, volatile, with a suffocating smell, &c. There is not the least probability of confounding it with any thing else.

The tache from phosphorus possesses three different shades, brilliant white, brilliant yellow, and rust color. When the quantity of phosphorus is very small, either the first, or only the first and second are seen. It is volatile, reddens litmus paper, and is insoluble in cold nitric acid, so that there cannot be the least occasion for mistaking between this and arsenic.

The next substance that produces a tache when introduced into the apparatus in question, is iron, but it ought not to be classed with the others, for I am firmly convinced that it is not due to any iron that may be dissolved by the hydrogen; in other words that there is no ferruginous hydrogen. My reason for so believing is based upon the following facts:—If we desire to obtain this tache, a considerable quantity of iron, or some salt of iron, must be used, and the gas made to generate rapidly. Now observe what must take place. The action of the liquid being violent, a spray is formed, which consists of the dilute acid and whatever salts it may hold in solution, in this case iron as one; this spray passes along with the hydrogen through the jet; the hydrogen being now ignited, a porcelain surface is placed in contact with the flame, which, becoming heated, enables it to evaporate the water from the salt of iron, which deposits itself, and afterwards becomes decomposed by a continuation of the heat, the

peroxide being left. If we still retain the iron in the apparatus, but make the action not very brisk, no tache will exhibit itself upon a smooth porcelain surface; but if the broken surface of a piece of porcelain is placed in contact with the flame, a slight black deposit is formed, consisting, as in the former case, of peroxide of iron; the reason of this is, that it is a more convenient surface for retaining the particles of the solution of iron thrown out in company with the hydrogen. Again, this tache is evidently an oxide, which it is not probable would be the case, had the iron been chemically combined with the hydrogen. Another reason is, that if the gas be made to traverse water or chloride of calcium before ignition, no tache will be formed, for the iron mixed with the hydrogen is retained by either of these means. This tache has been perhaps more noticed than it deserves. It is not easily produced, and is distinguished by its not being volatile and its solution in any of the strong acids, giving a blue precipitate with ferrocyanuret of potassium.

There is yet one other tache to be spoken of. If the flame of the apparatus, containing only zinc, sulphuric acid and water, be prolonged for some time upon one spot on the porcelain, an opake white tache will be perceived, which I propose to explain in the same way as the last, the cause of it being the oxide of zinc instead of iron, this oxide arises from the decomposition of a small quantity of sulphate of zinc thrown out with the hydrogen, but still it is a thing hardly worthy of notice, for after it is formed it is difficult to see it.

What is the conclusion to be arrived at concerning Marsh's apparatus, after what has been said? Why, that it should be considered as the most valuable instrument that the medico-jurist possesses, to assist him in his experiments upon the poison in question; for with proper care all the objections to it can be easily remedied, and the character of each tache is so well marked that they need never be confounded, as will be seen by glancing the eye over what follows.

Arsenic—Steel color, highly metallic, easily volatilized by heat, readily dissolved in nitric acid; the nitric acid solution gives with nitrate of silver a brick-red precipitate.

Antimony—Color darker than steel, metallic, with difficulty volatilized by heat, readily dissolved in nitric acid; the nitric acid solution gives with nitrate of silver no precipitate.

Sulphur—Color sulphur-yellow, easily volatilized by heat, not soluble in nitric acid, gives the well known smell of sulphur when burnt.

Phosphorus—Color brilliant from white to red, easily volatilized by heat, not soluble in nitric acid, reddens litmus paper.

Iron—Color black but slightly metallic, not volatilized by heat, soluble in nitric acid; the nitric solution strikes a blue color with ferrocyanuret of potassium.

Examination for arsenic in case of poisoning.

Under this head will be answered the fourth question, which is, What are the best means not only of detecting, but of ascertaining the quantity of arsenic in combination with animal matter?

Arsenious acid, it is well known, does not destroy life by a mere local action upon the stomach and intestines, as do many of the strong acids, but that its poisonous effects are exhibited after it has been absorbed into the system. It is true that it inflames the mucous membrane of the intestinal canal, but that is comparatively of minor importance to its other effects. If it be absorbed, in what secretions and in what organs is it to be found in the greatest abundance? The urine is the first secretion in which arsenious acid exhibits itself, and in that not long after administration. This fact, then, makes it important to preserve the urine of a person who we may suppose has been poisoned by this agent, for making the necessary medico-legal examination, and in cases where death does not occur it ought to be considered of more value than the matter vomited.

After the bladder, the liver and heart next demand our attention, for one may calculate with almost absolute certainty upon finding this substance in these organs, had it been employed. The brain and inner muscles of the thigh, in most cases of poisoning by arsenious acid, contain it in sufficient quantity to be exhibited by means of Marsh's apparatus. Other portions of the body frequently contain it in small quantities, but if we have the organs already mentioned, along with the stomach, intestines, and their contents, it will be all that it is important to experiment upon.

In commencing the experiments we should be furnished with the following materials, viz. nitric and sulphuric acids, nitrate of potash, zinc and water. Their purity should be fully established before they are employed.

The use of the nitric acid is to carbonize the animal matter, and in that way to develope any arsenic that it may contain. This process is of vast importance, as will be seen by the following example. Let the liver contain the largest quantity of arsenious acid that can reach it by the process of absorption, and it may be boiled for six hours, in distilled water, without giving up the smallest portion of the poison; whereas, carbonize it first by the aid of nitric acid, and then pour the water upon it, and results of an entirely different nature will be obtained. There are, no doubt, two reasons for the cause of this; the first is, that the arsenious acid has undergone some chemical change, which renders it insoluble; the second is, that the liver is completely broken up by the nitric acid, and the arsenic, in whatever state it may have existed, is now converted into arsenic acid. The nitrate of potash is sometimes employed to destroy the carbon after the nitric acid has acted upon the animal matter. The sulphuric acid, zinc and water, are the elements of Marsh's apparatus.

The fluid of the stomach and intestines should be first experimented upon; and this may be introduced into the apparatus either in its crude state, or after having undergone carbonization by heat or nitric acid. If it be employed uncarbonized, we may expect a great quantity of froth, which may be obviated in some measure by the means already mentioned. When we carbonize the matter by heat, it becomes necessary to introduce a small portion of pure caustic potash during its evaporation, which combines with arsenious acid, forming arsenite of potash, a substance not easily volatilized. If nitric acid be used, we first evaporate the liquid to dryness, then pour upon it two or three times its bulk of nitric acid, and again evaporate to dryness, when we may expect an almost complete destruction of the animal substances. The carbonized matter, formed either by heat or nitric acid, with whatever it may contain, is digested for a little while in pure water, which easily dissolves the arsenic, now in the states of arsenite of potash and arsenic acid. Filter, introduce the liquid into the apparatus, when we may expect to exhibit the metal upon a porcelain surface. In experimenting upon the urine, the same steps are to be taken.

The examination of the liver is conducted as follows:—Two or three pounds of it are first dried by a gentle heat, and then digested with about three times as much nitric acid by weight,

until the mass becomes perfectly dry; water is now poured upon it, and heat applied for ten or fifteen minutes; the liquid is now filtered, and tested by the apparatus. The heart, muscles, brain, &c., if examined, must undergo the same process.

There is yet another advantage, that has not been mentioned, connected with the carbonization of animal matter by nitric acid; it is, that if antimony be present, it becomes converted into antimonious acid, which is insoluble in water.

Mention has been made only of the manner of separating arsenic from animal matter, by the aid of Marsh's apparatus, and it may be well to give a brief account of one or two new methods adopted by Mr. Persoz to serve the same end, with this additional advantage, that it enables one to ascertain the exact amount present.

The suspected materials, after having sufficient reason to suppose that they do not contain a poison of organic origin, or mercurial or antimonial preparations, are subjected to the action of dilute nitric acid, in order to destroy those parts that are decomposed by this agent. Most of the organic substances having undergone this decomposition, the residue is diluted with water, and heated to the boiling point, and then left to cool; the fatty and resinous substances rise to the surface, are taken off and washed, and the washings added to the original liquid, which is then evaporated to the consistency of syrup. The liquid now has a dark brown tint, an evidence that it still contains a quantity of organic matter. Nitric acid, therefore, is again added, and a new oxidation takes place. We recommence to evaporate, and continue to add nitric acid, until the liquid acquires a lively orange tint, when a careful evaporation is commenced, first over a naked fire, and then by the means of vapor. An approximate value being made of the quantity of residue, twice and a half times its volume of pure nitrate of potash is added, for the purpose of completing the oxidation. Water is next poured upon these materials, and heat applied and continued until the water is evaporated and the residue is dry; by this means an intimate mixture is brought about between the nitre and animal substances. In this part of the operation, care must be taken to extend the matter as much as possible over the surface of the capsule as soon as it begins to dry. The capsule is now heated almost to redness, when a deflagration takes place, and propagates itself through all the

matter submitted to analysis, destroying all remains of organic matter. Care must be taken that the nitre be in sufficient quantity, for if not, this part of the process must be gone over a second time.

After the deflagration has taken place, it may be well to heat the residue a second time, in a capsule of platinum or silver, to redness. The residue consists generally of the following substances: the excess of nitrate of potash mixed with the nitrite of the same substance; carbonate of potash; the salts existing in the organic matter, as well as those formed during the process, such as the phosphates, sulphates and chlorides, free oxides, and finally arsenic acid, free and in combination with potash. This compound mass being pulverized, is mixed with one and a half times its bulk of hydrochlorate of ammonia, introduced into a retort, and heated to a dull redness. By the action of the heat, the chlorine of the hydrochlorate of ammonia combines with the potassium, and the hydrogen of the ammonia reduces the arsenic acid to the state of arsenious acid, which sublimes with the excess of hydrochlorate of ammonia, and is condensed on the upper part and neck of the retort. Other chemical changes take place, but they do not modify the one just stated. The operation being finished, the retort is broken, and the substance sublimed dissolved in water strongly acidulated with hydrochloric acid, and through this solution is passed sulphuretted hydrogen, which enables us to obtain all the arsenic that was originally in combination with animal matter, in the state of a pure sulphuret. This process is somewhat complicated, but each step is so clear, that with proper care, the most satisfactory result might be obtained in almost all cases.

In fulfilling the promise as regards the stating of all important facts lately brought to light concerning this too universal poison, I will mention two other methods of separating and of ascertaining the quantity of arsenic in combination with organic substances. They are both modifications of Marsh's apparatus; one is proposed by M. Lassaigne, and the other by myself.

M. Lassaigne, instead of igniting the arsenuretted hydrogen, and obtaining the arsenic upon a cold surface, passes it through a solution of nitrate of silver, which it has the property of decomposing. The solution first becomes brown, and then a deposit of oxide of silver takes place. After the gas has ceased to pass, a

quantity of muriatic acid is poured upon it, which decomposes what nitrate of silver remains, and converts the precipitate into chloride of silver. There remains now in solution arsenic and arsenious acids, and by filtering and evaporating to dryness, they are obtained.

I propose to pass the arsenuretted hydrogen through a tolerably strong solution of iodine in alcohol, in order to decompose it, which it does effectually, there being formed the iodide of arsenic, which remains in solution. All that is now necessary to be done, is to evaporate nearly to dryness, until red fumes make their appearance, and then pour twice or thrice as much nitric acid as there is residue into the capsule. Heat is again applied, and the evaporation continued to dryness, when there will be remaining arsenic and arsenious acids. The nitric acid in this case converts the iodine of the iodide of arsenic, and the free iodine into iodous and iodic acids, both of which are evaporated with the undecomposed nitric acid.

Iodine also decomposes the antimoniacal hydrogen, first forming iodide of antimony, which the water of the alcohol immediately decomposes into hydriodic acid and oxide of antimony, the latter of which is precipitated. This then becomes a convenient mode of separating the two substances, antimony and arsenic, for by passing the compound gas through the alcoholic solution of iodine, it becomes decomposed, and iodide of arsenic is formed, which remains in solution, and the oxide of antimony which is precipitated, can be separated by means of a filter. This, however, is not the plan that I would propose; it would be better to invert the precipitate as well as the liquid into a capsule, evaporate and treat with nitric acid as in the case of arsenic, when we shall have left the arsenic, arsenious and antimonious acids, the two former of which are soluble in water.

One may now imagine that there is nothing easier for the medico-jurist than to form a correct opinion, and one that cannot be doubted, concerning the poisoning by arsenic. Whether such is the fact or not, he will find, in some cases, that all his skill and care will be required, not only to convince the minds of others, but even his own. It may not unfrequently occur, that arsenious acid has been the poisoning agent, and still great difficulties present themselves, which are enumerated in almost all works on medical jurisprudence.

There is one very important fact to be kept in mind with reference to examinations of this character; it is the medical treatment that the individual has been subjected to before death. For instance, the treatment by diuretics, which will be mentioned presently, may remove from one or more organs the poison previously contained in them, and still the impressions made upon them be too strong to be recovered from. How then is this difficulty to be removed? By carefully preserving all the urine—an observation which is of such importance that it should not escape the memory of any physician.

What are the best means of treating the poisonous effects of arsenic?

A few words upon two new methods of treating the effects of arsenic, will conclude this article, already extended much farther than I had intended.

The remedies that we already possess, are, at the very best, but feeble agents to combat the effects of this poison. The one most to be relied on is the hydrated peroxide of iron, it being a veritable antidote to poisoning by arsenic; however, there are some objections, the principal of which is the slowness of its absorption, for it is only where it encounters the poison that its salutary effects are displayed, by forming with it an inert arsenite of iron.

A treatment proposed in Italy, is the administration of stimulant draughts every two or three hours, consisting of brandy one ounce, wine two ounces, bouillon (the liquid produced by boiling beef or other meat in water) four ounces. It is based upon the supposition that the effects of arsenic are atonic, the truth of which is far from being established. Instances are given where this treatment has proved efficacious, although I have witnessed experiments made with it, in comparison with simply tepid water, where the latter proved to be the most successful of the two.

The treatment by diuretics is one that deserves some consideration; it is advanced by M. Orfila, based upon numerous experiments. It has been more than once stated, that the urine exhibits a large portion of the arsenious acid absorbed into the system, and it seems very rational to suppose, that if this secretion could be augmented by any means, that the quantity of arsenic carried off would be also increased. It has been observed, that where equal quantities of arsenious acid have been given to two dogs of

equal vigor, and if one died and the other survived its effects, we find that the latter had urinated largely. The diuretics merit some attention; they are not to be used until the stomach is emptied of its contents by some mild emetic and tepid water.

In a medico-legal examination for antimony, most of the steps that have been proposed in the case of arsenic can be followed; the principal modification is where either nitric acid or heat has been used to carbonize the animal matter; for in that case, muriatic acid slightly diluted is to be employed as the dissolving agent instead of water.

Paris, December 6, 1840.

ART. VI.—*On the Extrication of the Alkalifiable Metals, Barium, Strontium, and Calcium; by* ROBERT HARE, M. D., Professor of Chemistry in the University of Pennsylvania.

Read before the American Philosophical Society, October 4, 1839.

IN the autumn of 1820, I devised an innovation in the mechanism and in the mode of completing the circuit of an *extensive* voltaic series. Previously to that time, in using any form of the voltaic battery, the circuit had always been completed by making a communication between the electrodes,* after the submersion of the plates. In the case of the deflagrator, the electrodes might be made to communicate before the immersion of the plates, the circuit being completed by their immersion. Or, in case the electrodes should not be in contact before immersion, the operator was enabled to bring them together so nearly about the same time, as to avail himself of the pre-eminently energetic action which immediately succeeds the encounter between the plates and the solvent.

Fourteen years had elapsed, during which I had the regret of perceiving that the advantages of the deflagrator were not sufficiently estimated in Europe, when, about the year 1835, the celebrated Faraday,† while investigating the principles upon which galvanic apparatus should be constructed, came to a conclusion

* Agreeably to the suggestion of Faraday, I use the word electrode, for the pole of a voltaic series; also anode, for the positive pole, and cathode for the negative pole.

† See London and Edinburgh Philosophical Magazine and Journal, vol. viii, for 1836, p. 114.

that the deflagrator eminently associated the requisites of which he was in search, and stated many facts and arguments tending to prove that it was the most perfect form of the apparatus at that time known. More than twelve years ago, while I was operating with a deflagrator of three hundred pairs, each seven inches by three, I observed that, in a circuit made through a saturated solution of chloride of calcium, by means of a coarse platina wire (No. 14,) and a fine wire, (No. 26,) that when the latter was made the cathode and the former the anode, a most intense ignition resulted, causing the rapid fusion of the fine wire into globules like common shot. But when the situations of the wires were reversed, so that the smaller wire was made to form the anode, the ignition became comparatively so feeble as to be incompetent to fuse the fine platina wire. This phenomenon had continued to appear inexplicable, when, during the last winter, it occurred to me that the evolution and combustion of the calcium might be the cause of the superior heat produced at the cathode.

This led to the employment of chlorides in the process of Seebeck, Berzelius, and Pontin, for the production of amalgams from the earths, in which a cathode of mercury, and anode of platina were used. Accordingly, in operating with a deflagrator of three hundred and fifty Cruickshank pairs of seven inches by three, a mercurial amalgam was speedily obtained, which appeared sufficiently imbued with calcium to become speedily buried under a pulverulent stratum of lime, and mercury in a minute state of division.

Nevertheless, after exposure of the amalgam thus produced to the air, till all the calcium had been separated, and igniting the resulting powder to drive off the adhering mercury, the ratio of the weight of the lime thus obtained, to the mercury with which it had been united, was not over a five hundredth part. With a view to procure an amalgam in which the proportion of calcium should be greater, I was led to devise the following apparatus and process, of which an engraving and description are now laid before the society.

How far the result of my exertions, subsequently stated, may be considered in advance of the steps previously taken, will be evident from the fact that all the knowledge which exists, respecting the isolation of the metals of the alkaline earths, is due to the experiments and observations of Davy; and to what point

they extended may be learned from the following quotations from the Bakerian lectures of that celebrated chemist. In reference to his efforts to isolate the radical in question, the distinguished lecturer mentions "that to obtain a complete decomposition was extremely difficult, since nearly a red heat was required, and that at a red heat the bases of the earths acted upon the glass, and became oxygenated. When the tube was large in proportion to the quantity of amalgam, the vapor of naphtha furnished oxygen sufficient to destroy a part of the bases; and when a small tube was employed, it was difficult to heat the part used as a retort sufficiently to drive the whole of the mercury from the base without raising too highly the temperature of the part serving for a receiver so as to burst the tube." "When the quantity of amalgam was about fifty or sixty grains, I found that the tube could not be conveniently less than one-sixth of an inch in diameter, and of the capacity of about half a cubic inch. In consequence of these difficulties, in a multitude of trials, I had few successful results; and in no case could I be absolutely certain that there was not a minute portion of mercury still in combination with the metals of the earths."*

The observations are more than confirmed by my experience, which leads me to the conviction that the removal of the mercury is not to be accomplished thoroughly in glass vessels, and, of course that Davy was perfectly correct in supposing that the products which he described as barium and strontium, were alloys with mercury. I am also under the impression that the metals above mentioned decompose naphtha, when heated with its vapor, and enter into combination with its constituents. Had the barium which Davy obtained, been free from mercury, it would not have been fusible below a red heat, as alledged by him. Agreeably to my experience, that metal requires no less than a good red heat for its fusion.

In a subsequent paragraph he adds: "The metal from lime I have never been able to examine exposed to air or under naphtha. In the case in which I was enabled to distil the mercury from it to the greatest extent, the tube unfortunately broke while warm, and at the same moment when the air entered the metal, which

* See Transactions of the Royal Society, Part II. Nicholson's Journal, vol. xxi, for 1808; or, Tilloch's Philosophical Magazine, vol. xxxiii.

had the color of silver, took fire and burnt, with an intense white light, into quicklime."*

Had the failure of Sir Humphrey, in his efforts to isolate calcium, been due only to the accidental fracture of a glass tube, it would be inexplicable that a chemist so indefatigable should not have successfully reiterated the experiment; or that no other chemist, during thirty intervening years, should have succeeded by resorting to the same means. No doubt exists in my mind that without using a larger quantity of mercury than the sixty grains which he employed, and resorting to other materials than glass for a distillatory apparatus, no chemist could succeed in the isolation of calcium, nor in the complete distillation of the mercury from the amalgams of the other metals, so as to obtain available quantities for examination.

In a subsequent communication to the Royal Society, Davy mentions, that "by passing potassium through lime and magnesia, and then introducing mercury, I obtained solid amalgams, consisting of potassium, the metal of the earth employed, and mercury."

"The amalgam from magnesia was easily deprived of its potassium by water." Of the amalgam containing calcium he makes no farther mention, but suggests the possibility of obtaining, by operations performed in this manner, quantities of the metals of the earths sufficient for determining their nature and agencies.†

But I will proceed to explain and describe the apparatus and process to which I have resorted, and to communicate the results which I have obtained.

A Description of the Apparatus and Process for obtaining amalgams of Calcium, Barium, and Strontium from saturated solutions of their Chlorides, by exposure to the Voltaic circuit in contact with mercury.

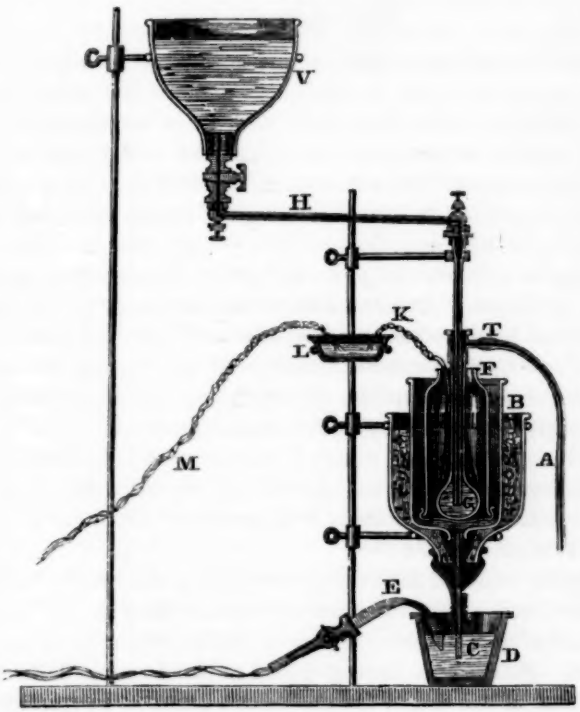
A and B, two bell glasses, with perforated necks, were inverted and placed one within the other, so that, between them, there was an interstice of half an inch, which was filled with a freezing mixture. Concentrically within B a third similar bell F,

* See Transactions of the Royal Society, Part II. Nicholson's Journal, Vol. xxi, for 1808; or, Tilloch's Philosophical Magazine, Vol. xxxiii.

† Transactions Royal Society for 1810, part I, p. 62. Tilloch's Magazine, vol. xxxvi, p. 87.

was placed, including a glass flask, of which the stem extended vertically through the neck of F. From a vessel V, with a cock intervening, a tube luted to the orifice of the flask extended to the bottom of it, so as to convey thither from V a current of ice-water, which, after refrigerating the bulk of the flask, could escape through the nozzle projecting, horizontally, from the neck, T. The mercury in the capsule D communicates through the rod with the negative poles of one or more deflagrators. The capsule L in like manner with the corresponding positive poles.

Fig. 1.



A rod of platina reaches from some mercury in the capsule D, through the necks of the beds A and B, into a stratum of mercury, resting upon shoulder of the bell glass B, so as to be about a quarter of an inch beneath the flask. Several circumvolutions of platina wire, No. 14, forming a flat coil, were interposed between the mercury and the bottom of the flask. The recurved ends of

this wire were made to reach into the mercury in the capsule L. Over the mouth of the bell F, after the introduction of the flask and coil, some bed-ticking was tied, so as to prevent contact between the platina and mercury, and to check as much as possible, any reunion between the radical taken up by the one, and the chlorine liberated by the other. Into the bell T, a saturated solution of the chloride to be decomposed was poured, and some coarsely powdered crystals of the same compound added. Of course the solution, by penetrating the ticking, came into contact with the mercury.

Electrolytic Process.

The peculiar mechanism of my apparatus, by which, in ten seconds, the acid may be thrown *on* or *off* of the plates, enables the operator, within that time, after a due arrangement of the poles is made, to put either or both of the deflagrators in operation, or to suspend the action of either or both. This mode of completing or breaking the circuit gives a great advantage in deflagrating wires ; or in the processes, wherein dry cyanides, phosphurets, or carburets are to be exposed to voltaic action in vacuo, or in hydrogen. It enables us to arrange every part of the apparatus so as to produce the best effect upon the body to be acted upon, and then to cause a discharge of the highest intensity of which the series is capable, by subjecting the plates to the acid previously lying inactive in the adjoining trough.

In the case in point, where a chloride was to be decomposed, the deflagrators could be made to act through the same electrodes, either simultaneously or alternately. Of these facilities I thus availed myself:

Having supplied each deflagrator with a charge of diluted acid of one fourth of the usual strength, I began with No. 1, and at the end of five minutes superseded it by putting No. 2 into operation. Meanwhile, having added to No. 1 as much more acid as at first, at the end of the second five minutes, I superseded No. 2 by No. 1; and in like manner, again superseded No. 1 by No. 2. Having thus continued the alternate action of the deflagrators for about twenty minutes, both were made to act upon the electrodes simultaneously, the balance of acid requisite to complete the charge having been previously added.

By these means the reaction was rendered more equable than it could become in operating with one series more highly charged. Although, under such circumstances, the reaction may, at the outset, be sufficiently powerful to produce ignition, as I have often observed, after fifteen or twenty minutes it may become too feeble in electrolyzing power to render the continuance of the process in the slightest degree serviceable. Agreeably to my experience, as the ratio of the calcium to the mercury increases, the amalgam formed becomes so much more electro-positive as to balance the electro-negative influence of the voltaic current. After reacting with one series of two hundred pairs, of one hundred square inches each, for seventy minutes, I have found the proportion of calcium to be only one six-hundredth of the amalgamated mass obtained.

In this lies the great difficulty of obtaining any available quantity of the radicals of the alkaline earths by electrolyzation; especially in the case of calcium. It is easy, by a series of only fifty pairs, to produce an amalgam with that metal, which, when exposed to the air, will become covered with a pulverulent mixture of lime and mercury; but, in such case, the quantity of calcium taken up by the mercury, when estimated by the resulting oxide, will be found almost too small to be appreciated by weighing. To increase the quantity of calcium to an available extent I have found extremely difficult, since, as the process proceeds, the chemical affinity becomes more active, while the electrolyzing power becomes more feeble.

That a change should be effected in mercury, giving to it the characteristics of an amalgam, by the addition of a six hundreth part of its weight, cannot be deemed difficult to believe, when it is recollected that Davy found that when, by amalgamation with ammonium, a globule of mercury had expanded to five times its previous bulk, it had gained, in weight, only one twelve thousandth part.*

As the affinity between the chlorine and the radicals of the alkaline earths increases in strength with the temperature, and as heat is evolved in proportion to the energy of the voltaic action, the disposition of the elements separated by electrolyzation to reunite is, in this way, promoted. Hence the necessity of refrigeration.

* Sixty grains of mercury contained only one two hundredths of a grain. See Nicholson's Journal, Vol. xxxiii, p. 213.

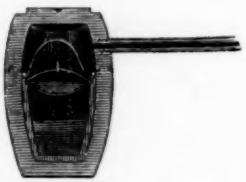
The best index of the success of this process is the evolution of chlorine; since in proportion to the quantity of this principle extracted at the anode, must be the quantity of calcium separated at the cathode. During my operations, chlorine was evolved so copiously as to tinge the cavity of the innermost bell with its well known hue. Hence, when the evolution of chlorine ceases to be very perceptible, the amalgam should be extricated from the apparatus, and separated by a funnel and the finger from the solution of chloride, and immediately subjected to distillation.

It has been mentioned, that in the electrolytic process above described I resorted to the alternate action of two deflagrators. This was effected by making the negative poles of both communicate with the mercury in capsule D, while the positive poles communicated with some mercury in capsule L. For a description of the deflagrators employed, I refer to the American Philosophical Transactions, vol. v, or to this Journal, vol. xxxii, p. 285, as those which I employed were of the kind there described.

I have found great benefit to arise from Mr. Sturgeon's expedient of amalgamating the surfaces of the zinc; which Faraday has represented as giving, to a great extent, the properties of a sustaining battery. Agreeably to my experience, it renders the plates less liable to be encrusted with suboxide of zinc and copper, which always impairs the energy of a voltaic series.

Distillatory Apparatus and Process.

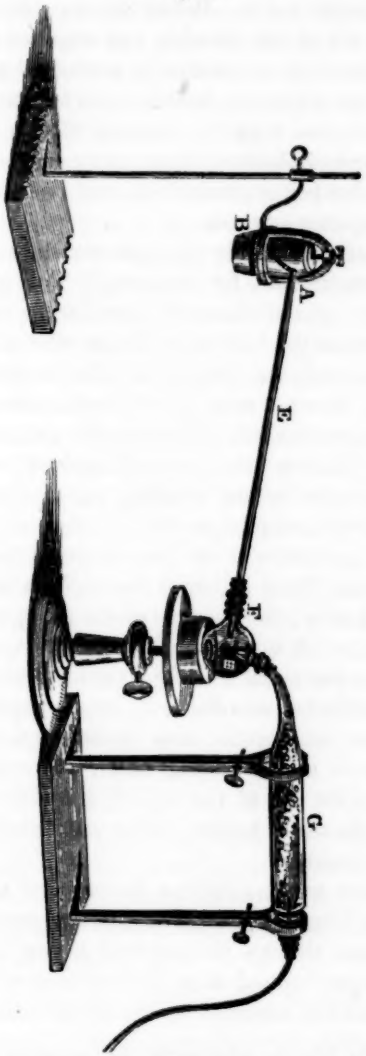
Fig. 2.



A quantity of the amalgam, weighing about three thousand grains, was introduced into an iron crucible. Of this crucible a section is represented by Fig. 2, which was forthwith closed by a capsule seated in a rabbet, or groove, made on purpose to receive it. The capsule being supplied with about half a dram of caoutchouchine, was then covered by the lid. In the next place, by means of a movable handle, or bail, of wire so constructed as to be easily attached, the crucible was transferred to the interior of the body of the alembic, A. Into the cavity thus occupied, about a dram measuse of naphtha was poured. The canopy, A, and body of the alembic, B, were then joined, (as represented in Fig. 3,) with the aid of a luting of clay and borax between the grooved juncture, and the pressure of the stirrup screw provided for that purpose.

A communication was made between the alembic and a small tubulated glass receiver, by means of an iron tube thirty inches

Fig. 3.



long, and a quarter in bore. The tubulure of the receiver received the tapering end of an adopter, G, which communicated

with a reservoir of hydrogen by means of a flexible lead pipe. The length of the tube prevented the alembic, or receiver, from being subjected to the agitation which results from the condensation of the mercurial vapor. Before closing the juncture completely, all the air of the alembic was expelled by a current of hydrogen, desiccated in its passage by a mingled mass of chloride of calcium and quicklime contained in the adopter. By keeping up the communication with the reservoir of this gas, while subjected to a column of about an inch or two of water, the pressure within the alembic being greater than without, there could be no access of atmospheric oxygen.

The bottom of the alembic was protected by a stout capsule of iron, (a cast iron mortar, for instance.) The next step was to surround it with ignited charcoal, in a chauffer or small furnace, taking care to cause the heat to be the greatest at the upper part. By these means, and the protection afforded by the mortar, the ebullition of the mercury may be restricted to the part of its mass nearest to the upper surface. Without this precaution, this metal is liable to be thrown into a state of explosive vaporization, by which it is driven out of the crucible, carrying with it any other metal with which it may be united.

On the first application of the fire, the caoutchouchine distilled into the receiver. Next followed the naphtha from the body of the alembic. Lastly, the mercury of the amalgam distilled; the last portions requiring a bright red heat, in consequence of the affinity between the metal and the alkalifiable radical.

After the distillation was finished, the apparatus having been well refrigerated, the alembic was opened and the crucible removed. As soon as the lid was taken off, some naphtha was poured between the rim of the capsule and sides of the crucible, so as to reach the metal below. This was found adhering to the bottom of the crucible.

When the heat was insufficient to carry off all the mercury, the metal was found in a state somewhat resembling metallic arsenic in texture, though its susceptibility of oxidation, and its affinity for carbon, caused it to be deficient of metallic lustre, until the surface was removed by the file or burnisher.

Properties of the Metals obtained by the processes above mentioned.

Either metal was rapidly oxydized in water, or in any liquid containing it; and afterwards, with tests, gave the appropriate

proofs of its presence. They all sank in sulphuric acid; were all brittle and fixed; and, for fusion, required at least a good red heat. After being kept in naphtha, their effervescence with water is, on the first immersion, much less active. Under such circumstances they react, at first, more vivaciously with hydric ether than with water, or even chlorohydric acid; because in these liquids a resinous covering, derived from the naphtha, is not soluble, while to the ether it yields readily.

By means of solid carbonic acid, obtained by Mitchell's modification of Thilorier's process, I froze an ounce measure of the amalgam of calcium, hoping to effect a partial mechanical separation of the mercury by straining through leather, as in the case of other amalgams. The result, however, did not justify my hopes, as both metals were expelled through the pores of the leather simultaneously, the calcium forming, forthwith, a pulverulent oxide, intermingled with, and discolored by mercury in a state of extreme division.

By the same means I froze a mass of the amalgam of ammonium as large as the palm of my hand, so as to be quite hard, tenacious and brittle. The mass floated upon the mercury of my mercurial pneumatic cistern, and gradually liquefied, while its volatile ingredients escaped.

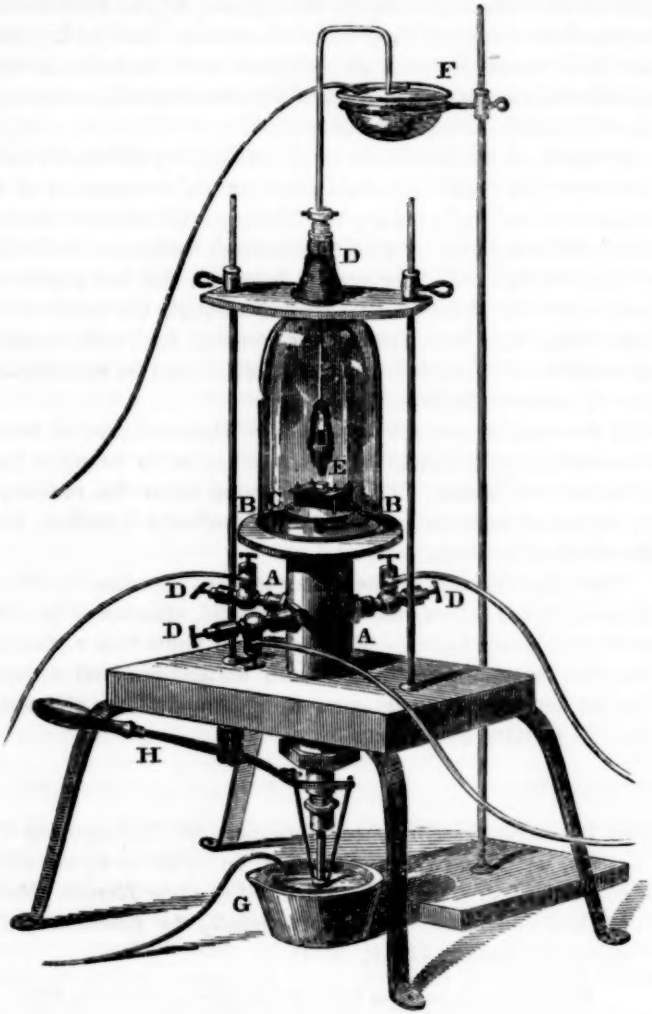
When the freezing of the amalgam was expedited by the addition of hydric ether, the resulting solid effervesced in water, evolving ethereal fumes. This seems to show that a portion of this ether may be incorporated with ammonium and mercury, without depriving the aggregate thus formed of the characteristics of a metallic alloy.

ART. VII.—*Description of an Apparatus for Deflagrating Carburets, Phosphurets, or Cyanides, in vacuo or in an Atmosphere of Hydrogen, with an account of some Results obtained by these and by other means; especially the Isolation of Calcium;* by ROBERT HARE, M. D.

Read before the American Philosophical Society, October 18, 1839.

UPON a hollow cylinder of brass (A A) an extra air-pump plate (B B) is supported. The cylinder is furnished with three valve cocks, (D D D,) and terminates at the bottom in a stuffing-box,

through which a copper rod slides so as to reach above the level of the air-pump plate. The end of the rod supports a small horizontal platform of sheet brass, which receives four upright screws.



These, by pressure on brass bars extending from one to the other, are competent to secure upon the platform a parallelopiped of charcoal. Upon the air-pump plate a glass bell is supported, and

so fitted to it by grinding, as to be air-tight. The otherwise open neck of the bell is also closed air-tight by tying about it a caoutchouc bag, of which the lower part has been cut off, while into the neck a stuffing-box has been secured air-tight. Through the last mentioned stuffing-box a second rod passes, terminating within the bell in a kind of forceps, for holding an inverted cone of charcoal, (E.)

The upper end of this sliding rod is so recurved as to enter some mercury in a capsule, (F.) By these means and the elasticity of the caoutchouc bag, this rod has, to the requisite extent, perfect freedom of motion.

The lower rod descends into a capsule of mercury, (G,) being in consequence, capable of a vertical motion, without breaking contact with the mercury. It is moved by the aid of a lever, (H,) connected with it by a stirrup working upon pivots.

Of course the capsules may be made to communicate severally with the poles of one or more deflagrators. The substance to be deflagrated is placed upon the charcoal forming the lower electrode, being afterwards covered by the bell, as represented in the figure. By means of the valve-cocks and leaden pipes a communication is made with a barometer gage; also with an air-pump, and with a large self-regulating reservoir of hydrogen.

The air being removed by the pump, a portion of hydrogen is admitted and then withdrawn. This is repeated, and then the bell glass, after as complete exhaustion as the performance of the pump will render practicable, is prepared for the process of deflagration in vacuo. But, if preferred, evidently hydrogen or any other gas may be introduced from any convenient source by a due communication through flexible leaden pipes and valve-cocks.

Having described the apparatus, I will give an account of some experiments, made with its assistance, which, if they could have illuminated science as they did my lecture room, would have immortalized the operator. But, alas, we may be dazzled, and almost blinded by the light produced by the hydro-oxygen blow-pipe, or voltaic ignition, without being enabled to remove the darkness which hides the mysteries of nature from our intellectual vision.

I hope, nevertheless, that some of the results attained may not be unworthy of attention; and that, as a new mode of employ-

ing the voltaic circuit, my apparatus and mode of manipulation will be interesting to chemists.

An equivalent of quicklime, made with great care from pure crystallized spar, was well mingled, by trituration, with an equivalent and a half of bicyanide of mercury, and was then enclosed within a covered porcelain crucible. The crucible was included within an iron alembic, such as has been described by me in this volume, as employed for the isolation of metallic radicals. (See page 300.)

The whole was exposed to heat approaching to redness. In two experiments the residual mass had such a weight as would result from the union of an equivalent of cyanogen with an equivalent of calcium.

A similar mixture being made, and, in like manner, enclosed in the crucible and alembic, it was subjected to a white heat. The apparatus being refrigerated, the residual mass was transferred to a dry glass phial with a ground stopper.

A portion of the compound thus obtained and preserved was placed upon the parallelopiped of charcoal, which was made to form the cathode of two deflagrators of one hundred pairs, each of one hundred square inches of zinc surface, co-operating as one series.

In the next place, the cavity of the bell-glass was filled with hydrogen, by the process already described, and the cone of charcoal being so connected with the positive end of the series as to be prepared to perform the office of an anode, was brought into contact with the compound to be deflagrated. These arrangements being accomplished, and the circuit completed by throwing the acid upon the plates, the most intense ignition took place.

The compound proved to be an excellent conductor; and during its deflagration emitted a most beautiful purple light, which was too vivid for more than a transient endurance by an eye unprotected by deep-colored glasses. After the compound was adjudged to be sufficiently deflagrated, and time had been allowed for refrigeration, on lifting the receiver, minute masses were found upon the coal, which had a metallic appearance, and which, when moistened, produced an effluvium, of which the smell was like that which had been observed to be generated by the silicuret of potassium.

Similar results had been attained by the deflagration, in a like manner, of a compound procured by passing cyanogen over

quicklime, enclosed in a porcelain tube heated to incandescence.*

Phosphuret of calcium, when carefully prepared, and, subsequently, well heated, was found to be an excellent conductor of the voltaic current evolved from the apparatus above mentioned. Hence it was thought expedient to expose it in the circuit of the deflagrator, both in an atmosphere of hydrogen and in vacuo. The volatilization of phosphorus was so copious as to coat nearly all the inner surface of the bell-glass with an opake film, in color resembling that of the oxide of phosphorus, generated by exposing this substance under hot water to a current of oxygen.†

The phosphuret at first contracted in bulk, and finally was, for the most part, volatilized. On the surface of the charcoal, adjoining the cavity in which the phosphuret had been deflagrated, there was a light pulverulent matter, which, thrown into water, effervesced, and, when rubbed upon a porcelain tile, appeared to contain metallic spangles, which were oxydized by the consequent exposure to atmospheric oxygen.

In one of my experiments with the apparatus above described, portions of the carbon forming the anode appeared to have undergone complete fusion, and to have dropped in globules upon the cathode. When rubbed, these globules had the color and lustre of plumbago, and, by friction on paper, left traces resembling those produced by that substance. They were susceptible of reaction neither with chloro-hydric nor with nitric acid, neither separately nor when mixed. They were not in the slightest degree magnetic.

About 1822, Professor Silliman obtained globules, which were at first considered as fused carbon, but were subsequently found to be depositions of that substance transferred from one electrode

* After the above mentioned experiments were made, I was led to believe that the compound, obtained as above described by heating lime with bicyanide of mercury, contained fulminic acid, or an analogous substance. The mass being dissolved in acetic acid, and the filtered solution subjected to nitrate of mercury, a copious white precipitate resulted. This, being desiccated, proved to be a fulminating powder. It exploded, between a hammer and anvil, with the sharp sound of fulminating silver.

† The compound usually designated as the phosphuret of calcium consists, according to Thomson, of one atom of phosphate of lime, as well as two atoms of pure phosphuret. Hence it is easy to see that the oxygen which enters into the constitution of the oxide, deposited, as above mentioned, upon the interior surface of the bell-glass, is derived from the phosphate.

to the other. Several of these globules were, by him, sent to me for examination, of which none, agreeably to my recollection, appeared so much like products of fusion as those lately obtained.

Formerly plumbago was considered as a carburet of iron, but, latterly, agreeably to the high authority of Berzelius, has been viewed as carbon holding iron in a state of mixture, not in that of chemical combination. It would not, then, be surprising if the globules which I obtained consisted of carbon converted from the state of charcoal into that of plumbago.

ART. VIII.—*Abstract of the Proceedings of the Tenth Meeting of the British Association for the advancement of Science.*

THE tenth meeting of this body was held at Glasgow, during the week commencing on the 16th of September, 1840. From the report published in the London *Athenæum*, is prepared the following abstract, in which, on account of our limited space, we are obliged to omit some details, which are less within the scope of this Journal.

The number of members at this meeting, was 1353, viz. new members, 995; old life members, 121; old annual members, 107; foreigners, 40. The property of the Association is £5895 1*s.*; the year previous it was £6588 0*s.* 4*d.*; the reduction being caused by the large grants paid during the year, for scientific uses. These payments amount to £1548 4*s.* 4*d.*

At the general meeting on Thursday evening, Sept. 17, Mr. Murchison read the report of the General Secretaries, in which was presented a brief view of what the Association had effected during the past year, as recorded in the last published volume of their transactions.

Professor Whewell was elected President of the Association, for the coming year. The next meeting will be at Plymouth, the precise time to be fixed by the Council, after consulting the local authorities.

Sect. A. *Mathematics and Physics.*

Major Sabine presented his *Report on the translation of foreign memoirs.* At the meeting at Newcastle, in 1838, a committee was appointed to procure and publish translations of for-

eign scientific memoirs, and the sum of £100 was placed at their disposal; and at the meeting in 1839, a further sum of £100 was allotted for the same object. The memoirs translated in the first year, under the superintendence of the committee, and at the expense of the Association, were :—

1. 'Remarks on the advancement of magnetical observatories, and a description of the instruments to be placed in them,' (with one plate) by Weber.
2. 'Method to be pursued during the magnetical term observations,' by Gauss.
3. Extract from the daily observations of magnetic declination, during three years at Göttingen, by Gauss.
4. Description of a small portable apparatus for measuring the absolute intensity of terrestrial magnetism, (with one plate) by Weber.
5. 'On the graphical representation of the magnetic term observations,' (with two plates) by Gauss.

For the translation and publication of these in Taylor's *Scientific Memoirs*, the first year's grant of £100 was paid to Mr. Taylor. In the present year, Ohm's memoir, entitled 'The galvanic circuit investigated mathematically,' has been translated at the expense of the Association, and given to Mr. T. for the 7th and 8th Nos. of the *Scientific Memoirs*. The Association have also paid for seven plates, representing the lines of magnetic declination, inclination, and intensity, computed by M. Gauss's theory. Translations of the eight memoirs below mentioned, have been gratuitously presented to the committee :—

1. Gauss 'On a new instrument for the direct observation of the changes of the intensity in the horizontal portion of the terrestrial magnetic force.'
2. Weber 'On the arrangement and use of the bifilar magnetometer.'
3. Gauss, 'General theory of terrestrial magnetism.'
4. Encke 'On the method of least squares.'
5. Bessel 'On the determination of the axes of the elliptic spheroid of revolution which most nearly corresponds to the existing measurements of arcs of the meridian.'
6. Weber, 'Description and use of a transportable magnetometer.'
7. Bessel 'On the barometrical measurement of heights.'
8. Rudberg, 'Experiments on the expansion of air.'

These translations have been placed by the committee, in the hands of Mr. Taylor, by whom they have been printed in the 6th, 7th, and 8th Nos. of the *Scientific Memoirs*.

Revision of the Nomenclature of the Stars.—Report of a committee appointed in 1838, consisting of Sir J. Herschel, and Messrs. Whewell and Baily. The revision of the northern hemisphere and the constellations visible in Europe, has been continued by Mr. Baily, by carefully tracing the just and most authentic limits of the existing and recognized constellations, and by a careful examination of the several stars, in the course of which many singular instances of confusion and error in naming and placing have been detected. This process, which involves an investigation of the history of each star, and of the designations it has received from each of its observers, and in the several catalogues in which it occurs, is nearly complete, and may be considered as clearing the ground for a systematic nomenclature of the northern stars, as well as for an effective table of synonyms of each star. In the southern hemisphere, or rather in those constellations which are visible only to an observer in that hemisphere, Sir John Herschel has continued, and nearly completed, a chart of *those stars only*, and of *all those stars* which are distinctly visible to the naked eye in a clear night; in which chart each star is represented of its true magnitude, according to a scale, in which the total interval from the stars of the first magnitude, to the lowest inserted, in place of six degrees, is made to consist of eighteen, so as to subdivide each magnitude into three. The final assignment of these magnitudes, resting on the collation and inter-comparison of an extensive series of observations, made for that express purpose with the naked eye, occasionally assisted by a common opera glass, has been a work of much time and labor, and is not yet quite completed. Nor till this is accomplished, can any further progress be made in the arrangement of the southern constellations, which at present are in a state of great confusion. A small part only of the grant of £50, has been expended, but the whole, will, no doubt, be required; and your committee therefore recommend its continuance.—Signed for the Committee, J. F. W. Herschel.

On the Reduction of the stars in Lacaille's Cœlum Australe Stelliferum, the committee report, that the reductions of all the stars are finished; and Mr. Henderson's assistant is at present arranging the results in the form of a catalogue, which however, could not be completed in time for this meeting. The completed portion, so far as finished, has been transmitted to Mr. Baily,

to be used in the construction of the new catalogue of the Astronomical Society. No money has been spent during the year; but of course, a renewal of the grant will be desirable.—Signed for the committee, J. F. W. Herschel.

Report on the reduction of Meteorological Observations made at the equinoxes and solstices, on the part of a committee appointed in 1838.—Sir J. Herschel, referring to his report of last year for the reasons why the reduction of these observations was not immediately commenced, reports further that the same reasons delayed any effective commencement of the work until very lately; but that owing to several wanting series of observations having at length come to hand, so as to render the series for the years 1835–8 tolerably consecutive, at least for several localities, your Committee considered it advisable to wait no longer, but proceed to work with the materials in hand. Accordingly, having cast the plan of operations for the comparison and projection of the barometric oscillations in those years, (to which for the present, your Committee propose to limit their proceedings, till it shall appear whether a further and more complete comparison, including the thermometric changes, and especially the correspondence of the winds, seems likely to lead to any valuable conclusions,) the reduction, arrangement and projection of the several series of observations was confided to the able and zealous hands of W. R. Birt, Esq., who is now actively employed in this operation, and who has enabled your Committee to lay before the meeting, as specimens of the mode of proceeding, the tabulation and projection of the observations made in the British Isles in the year 1836, which are, accordingly, submitted for inspection. In the discussion of these observations, it has been found advantageous to divide the stations from which they have emanated, into groups, according to geographical proximity, the chief of which are,—the group of the British Isles, that of the continent of Europe, the North American, South African and Indian groups. Each of these groups is referred, by applying the differences of longitude to the times of observation, to a central station; and the projected curves, in which the abscissæ are the mean times at that station, and the ordinates the reduced barometric altitudes, exhibit at one view the correspondence or disagreement of the barometric movements for all the stations of the group. * * * The projection of these curves is the first step in the process of reduction contem-

plated; and even in the very limited range afforded by the specimens now presented, affords ground for interesting remark. Thus we see that the march of the barometer in the only two Irish stations which have furnished observations, (Markree and Limerick,) while agreeing well with each other, differs most decidedly from its corresponding march in all the English stations; which, on the other hand, offer a good correspondence, *inter se.* * * It would be premature, at present, to enter fully into the details of the further steps contemplated in these reductions, as they will be, of necessity, materially influenced by the aspect under which the subject shall present itself in its progress, and especially by the discussion of one or two of the most complete series, among which, thanks to American zeal and industry, the group including the United States promises to be the most prominent. Only a very trifling sum (under £2,) has been hitherto expended (for the printing of the skeleton forms,) out of the original grant of £100; but the continuance of the grant will be required to meet the further requisite expenses. It is only justice to Mr. Birt to observe, that his part of the work appears to be executed with great care and judgment.—Signed, J. F. W. Herschel.

Reduction of the stars in Lalande's Histoire Céleste.—The Committee appointed to superintend the reduction of stars in the *Histoire Céleste*, report, that about 33,000 stars have been already reduced, the cost of which has been about £412, exclusive of about £52 for printing skeleton forms for the use of the computer. They further report, that there are about 16,000 more stars to be reduced, the cost of which will be about £200 more. As the original grant will not cover the whole of this expense, (there being only about £35 remaining out of that grant,) the Committee suggest the propriety of extending the grant for the ensuing year to the £200 above mentioned, which, they trust, will complete the work. Aug. 25, 1840.—Francis Baily.

Catalogue of Stars of Roy. Ast. Soc.—The Committee appointed to superintend the extension of the Royal Astronomical Society's Catalogue of Stars, report, that the work is in considerable progress, and that it will probably be completed before the next meeting of the British Association, in 1841. They further report, that £360 have been already paid for computations, and about £70 for printing and other expenses, making a total of about £430, out of the original grant for £500. As this balance

of £70, will not be sufficient to complete the work, the Committee request that it may be extended to £150, which they hope will meet every expense.

Report on Radiant Heat.—Prof. Whewell laid before the Section an abstract of Prof. Powell's Report on Radiant Heat. This report was supplementary to one furnished by Prof. P. to the Association at the Oxford meeting in 1832, and he now proposed to give an account of the progress of discovery since that period. Such a report was peculiarly required from the number and importance of the results arrived at in the interval, which though not sufficient to form the basis of an unexceptionable theory, have at least tended greatly to modify previous opinions, and to enable us to refer large classes of phenomena to something like a simple and common principle. The former report was divided into various heads, derived from what appeared in the then existing state of our knowledge, well-marked distinctions between several kinds of effects ascribed to radiant heat; but recent discoveries have in a great degree so changed our views on the subject, that these divisions cannot with any advantage or convenience be adhered to. One principle of arrangement, however, has been newly supplied in the discovery of the polarization of heat; so that all the researches to be described may be conveniently classed under two heads:—1st, as they relate to heat in its *ordinary* or *unpolarized* state; 2dly, as they relate to *polarized* heat. The report then entered on the first general head, by calling attention to the recent researches of Melloni and Forbes respecting the *transmission* and *refraction* of heat. Prof. P. adverted to the discovery of Melloni, that the resistance to the passage of heat is *not* exerted at the surface, but at the interior of the mass. This was a result of the observation, that the difference between the transmission of heat from a more highly heated source and from a less highly heated source, became less as the thickness of the screen was diminished, and disappeared when very thin screens were interposed. By comparing the transmissive powers of a great number of substances, he found that in crystallized bodies the diathermaneity for the rays of a lamp was proportional to their refractive powers; but in uncrystallized bodies no such law could be traced. It was in the course of these researches that Melloni made the important discovery of the singular property possessed by rock-salt,—viz. that it is almost entirely permeable to heat,

even from non-luminous sources. He found its transmissive power six or eight times greater than that of an equal thickness of alum, which had nearly the same transparency and refractive power; and that, unlike other diathermanous media, it is *equally* diathermanous to every species of heat, i. e. whether from sources highly heated or moderately heated; thus, he found a plate of 7 millimetres (.28 inch) thick, to transmit 92 out of 100 rays, whether from flame, red hot iron, water at 212°, or at 120° F. A plate one inch thick gave a similar constant ratio: the general conclusion resulting, that the source being a lamp, the diathermancy is not proportional to the transparency; and he makes some general remarks on these results, as related to those of Seebeck, on prismatic dispersion. In a supplementary paper, Melloni investigates the modifications which calorific transmission undergoes in consequence of the radiating source being changed. He employs four sources of heat:—1, a Locatelli lamp; 2, incandescent platinum; 3, copper heated by flame to about 730° F.; 4, hot water in a blackened copper vessel. The discovery of the complete diathermancy of rock-salt furnished the means of prosecuting the author's researches on the refraction of heat. In the successful experiment which he made, he concentrated in the focus of a rock-salt lens, the rays of dark heat from hot copper and hot water. A similar lens of alum produced no effect, which proves that the effect is not due to the mere heating of the central part of the lens. In discussing the properties of the calorific rays transmitted by different bodies, a remarkable effect presented itself; the rays of the lamp were thrown upon screens of different substances in such a manner that, either by changing the distances, or by concentration with a mirror or a lens of rock-salt, the effect transmitted from all the sources was of a certain constant amount. This constant radiation was then intercepted by a plate of alum, and it was found that very different proportions of heat were transmitted by the alum in the different cases; from which Melloni concludes, "that the calorific rays issuing from the diaphanous screens are of different qualities, and possess (if we may use the term,) the *diathermancy* peculiar to each of the substances through which they have passed." He next investigated the effects of *colored glasses*, and concludes that all the colored glasses except green, produce no 'elective action' on heat; green glass, on the contrary, transmits rays more easily stopped than

the others; and that green glass is the only kind which possesses a coloration for heat, (if we may use the term,) the others acting upon it only as more or less transparent glass of uniform tint does upon light. From experiments upon the solar rays transmitted by green glass, and intercepted by other media, he found they passed copiously through rock-salt, but feebly through alum: whence he concludes that there are among the solar rays some which resemble those of terrestrial heat; and in general, that the differences observed between solar and terrestrial heat, as to their properties of transmission, are therefore to be attributed merely to the mixture, in different proportions, of these several species of rays. Prof. Forbes repeated and extended Melloni's experiments on the transmission and refraction of heat. One of the most interesting points to which he directed his attention, was the possibility of detecting heat in the moon's beams. These, concentrated by a polyzonal lens of 32 inches diameter, and acting on the thermo-multiplier, gave no indication of any effect: so that Prof. F. considers it certain that if there be any heat, it must be less than the 300,000th part of a degree centigrade. In his third section, he investigates the index of refraction for heat of different kinds as compared with that for light in the same medium. The method of observation adopted was indirect, depending upon the determination of the critical angle of total internal reflection in a rock-salt prism with two angles of 40°, and one of 100°. By an ingenious mechanical contrivance, the sentient surface of the pile was made to receive rays coming from the source of heat after undergoing two refractions and one reflection, whatever was the angle of incidence. The mean of the results obtained from various sources of heat, variously transmitted, for the index of refraction for rock-salt, is 1.552. The results deduced are:—1. The mean quality, or that of the more abundant proportion of the heat from different sources, varies within narrow limits of refrangibility. 2. These limits are very narrow indeed where the direct heat of any source is employed. 3. All interposed media, (including those impermeable to light,) so far as tried, *raise* the index of refraction. 4. All the refrangibilities are inferior to that of the mean luminous rays. 5. The limits of dispersion are open to further inquiry, but the dispersion in the case of sources of low temperature, appears to be smaller than that from luminous sources.

The report then went on to the researches of Melloni on the reflection of heat; and the analogies of light and heat, as traced by Forbes and Melloni. He dissents from the opinion of Ampère, that the difference between heat and light is to be accounted for by the difference of wave length on the undulatory hypothesis. During these researches, he found that a certain kind of green glass colored by oxide of copper, though it permitted a portion of luminous rays to pass, absorbed all the calorific rays, so that it exhibited no calorific action capable of being rendered perceptible by the most delicate thermoscope, even when so concentrated by lenses, as to rival the direct rays of the sun in brilliancy. With respect to the transmission of heat by screens, Prof. F. remarked that Melloni's view of the transmission of heat of low temperature, by all substances alike, is equivalent to saying that substances in general allow only the more refrangible rays to pass, or that while rock-salt presents the analogy of white glass, by transmitting all rays in equal proportions, every substance hitherto examined acted on the calorific rays as violet or blue glass does on light, absorbing the rays of least refrangibility, and transmitting the others only. To this rule, Melloni made out the first exception, or the first analogue to red glass,—rock-salt with its surface smoked. Prof. F. soon pointed out another, viz. mica split by heat into numerous fine laminæ, and hence, as the effect was obviously mechanical, (since unlaminated mica produces no such effect,) he concludes that the smoked surface of the rock-salt acted also mechanically, and was thus led to try the effects of surfaces variously altered by mechanical means; and thus effects in some distant degree analogous to *sifting* the heat, were observed. Fine powders, also sifted on the surface, were found to affect the transmission of heat, and these Prof. F. considered analogous to diffraction and periodic colors in light. From these important researches, we have learned to connect modifications in the transmission of heat with the quality of refrangibility, and not as heretofore with a supposed difference of quality depending on the *source* of the heat. The report then gave an account of the researches of Dr. Hudson on radiation of heat, those of President Bache and Stark on the influence of color and surface on radiation, and Prof. P.'s experiments upon the repulsive power of heat; and adverted to Mr. Farquharson's theory of the formation of ice at the bottom of rivers, as a result from radiant

heat. From this opinion, Prof. P. dissents. The report then proceeds to the second division, on *polarized heat*, under which a detailed history of the several successive discoveries of Prof. Forbes on this subject was minutely given, with the dates of the several stages of the discoveries. Melloni having failed in repeating the experiments of Berard in polarizing heat by the tourmalin, and Nobili having in vain attempted it by reflection, Mrs. Somerville, in her *Connexion of the Physical Sciences*, 2d ed., speaks of it as altogether without experimental proof. In November, 1834, Prof. Forbes took up the subject and obtained complete success. He succeeded in polarizing heat from various sources, and by the aid of various substances, as piles of plates of mica, and by reflection and refraction, and showed that the peculiar modification of the experiments adopted by Berard, by reflection from glass, the quantity even at the maximum which could reach the thermoscope after two reflections, would be so extremely small, as that no difference of effect in the two rectangular positions could really have been perceptible. The entire series of those discoveries was completed between November, 1834, and January, 1835, the main practical improvement (which led to all the rest of the discoveries,) being the employment of the piles of mica. Prof. Forbes being at Paris in the summer of 1835, and finding both Biot and Melloni sceptical as to these results, he exhibited them to those philosophers with mica piles, which he prepared for the occasion, and which he left with Melloni. The next subject entered upon by Prof. F. was that of circular and elliptic polarization. This he determined both by depolarization, and also by the internal reflection of heat in a rhomb of rock-salt, as in the analogous cases of circular polarization of light. The report then adverted to the researches of Melloni on polarized heat, and entered minutely into historical details, and the theoretic views of the author; and then pointed out some expressions in Dr. Thomson's work on heat, which might lead a person who did not carefully attend to dates and facts, to attribute the priority of discovery to Melloni, and thus to deprive Prof. Forbes of a portion of his well-earned fame; and which was so clearly his due, that in 1836 the Keith prize had been awarded to him by the Royal Society of Edinburgh, after a close examination by the council of the researches and experiments; and subsequently the Rumford medal was adjudged to him by the Royal Society of

London, after similar precautions. The later researches of Forbes and Melloni on this subject, related to the connexion of these discoveries and the facts thus developed, with the undulatory theory. The report contained some remarks on the clearness with which the chronological order of the discoveries is marked in this case, and the consequent impossibility of any of those disputes which have sometimes tended to disturb the harmony of scientific inquiries. The continental philosophers have the merit of devising and bringing to perfection the instrument, by the aid of which alone, any discoveries in this very delicate field of research could have been expected. Prof. Forbes is the author of the discovery of the polarization of heat in all its branches, and from all its sources.

Prof. Forbes gave an abstract of his *Supplementary Report on Meteorology*. At the last meeting of the Association, he had been requested to make a report on the progress of meteorology since the period of his former report, which was drawn up in 1833. In obedience to that request he now came before them. He had distributed the matter of this report under the same general heads as those under which he had formerly treated of the several subjects. These were Temperature, Pressure, Humidity, Wind, Clouds, Rain, Electricity, Meteors, and suggestions on the first of these heads. In the report he had entered fully into the subject of the instruments used for measuring temperature, with their improvements, defects, and the cautions to be observed in using them. He enlarged on the decrease and accumulation of heat, and the curves which were used for elucidating these subjects. He spoke of the temperature decreasing in a geometrical series as you ascend through arithmetically increasing heights, the temperature being supposed constant, and entered on an examination of the paradoxical conclusion at which Poisson had arrived, that the upper surface of the atmosphere was, in consequence of the extreme cold there existing, in a state which he termed liquefaction. He observed that there are reasons for concluding that the temperature of space itself entirely beyond the atmosphere of the earth, was not so cold as Poisson seemed to suppose the highest portions of our atmosphere ; but that, independent of this opinion, there were other causes in operation quite sufficient to limit the extent of the atmosphere, without the aid of this startling supposition, and which limited height might be

considered as almost established, since Wollaston's proofs derived from the two entirely unconnected sources of astronomical and chemical phenomena. He then glanced briefly at the subject of isothermal lines, and passed on to the subject of solar radiation. He examined at great length the researches of Poisson on this subject; and pointed out what he considered the inadequacy of his speculations on what may be called the astronomical part of the total influence. The chief point insisted on in this branch, was, the neglect of Poisson to take into calculation the influence of the earth's atmosphere in diminishing the heating power of the sun's rays, particularly when they entered it obliquely. This he showed to be most important, by stating the fact, that at Paris the influence of the atmosphere upon rays entering vertically, was to reduce their heating influence by 25 per cent. of what it would have been had they not passed through it; when they entered so obliquely as to form an angle of 25° with the horizon, their heating influence was reduced to one half; and when an angle of 5°, to one twentieth part. If Poisson's views were correct, the total solar influence at Paris would be 24° centigrade; and as the mean temperature of Paris is 11°, this would leave about 13°, or about 9° of Fah., as the temperature irrespective of the sun's heat; whereas the mean temperature of the polar parts of the earth, which are so far from being totally deprived of solar influence, that they are alternately under that influence and deprived of it, is no higher than about 32°. He then proceeded to the consideration of the temperature of the earth below the surface,—gave a sketch of the results of former experiments, originating in those made in the caves under the Observatory at Paris; detailed the results of those lately made; and promised, before the meeting was closed, to bring up this subject again, in connexion with the experiments made at Edinburgh. Then he glanced rapidly at the subject of mean temperature, and showed, that while within the tropics it is sufficient to plunge a thermometer a foot under the surface of the earth, in order to get by its mean indication the mean temperature of the place, in higher latitudes this would not be sufficient; and he detailed the circumstances producing the difference, and pointed out the methods and precautions necessary for obtaining it. He then entered on the consideration of the temperature of the space beyond the earth, and stated the probable source of it to be the radiating in-

fluence of the stars. Under the head of *pressure*, the barometer, its construction and proper use, came under consideration. He pointed out the use of curves in recording and comparing its indications,—the great variety of its oscillations in the several parts of the earth, and the importance of accurate registers of its indications being kept,—alluding to the value of the hourly observations recorded, for so many years, under the inspection of Mr. Snow Harris, at Plymouth, and those at Leith and other places in Scotland, under the inspection of Sir D. Brewster. He next referred to a fact which seems to lead to the inference, that we must repose less confidence in the barometer as a means of measuring heights than has been heretofore supposed. It has been found by actually leveling between the Black Sea and the Caspian, that the latter is only 82 feet below the level of the former; whereas barometric measurements, founded on previous determinations, since carefully repeated, gave, in consequence of some unknown anomaly, the difference of 320 feet. The *humidity* of the atmosphere was the next topic discussed. As to the amount of vapor in the air, at any one instant, he considered that by the researches of Dr. Apjohn, begun at the suggestion of the Association, the important problem of the wet-bulb thermometer had been completely solved, and meteorologists thus put in possession of a simple and most effective instrument. The distribution of humidity in the atmosphere was next noticed. Under the head of *wind*, he alluded to the theory of Dove, which he said was comparatively unknown in these countries; and briefly spoke of the researches of Lieut. Col. Reid, Mr. Redfield, and Mr. Espy. Passing over the topics of *clouds* and *rain*, he promised to bring forward on a future day, some facts connected with extraordinary falls of rain which had been observed; but which, as stated by him, in one instance in his former report, had been in his absence called in question. Regarding *electricity*, he observed that little had been added either to our instrumental resources, or to our knowledge of the subject, since his former report. On the subject of *meteors*, the report contained all the recent information concerning the unusually numerous appearance of those which had been seen for some years, on the 12th and 13th of November, and 10th of August; and concluded by pointing out the advantages of public meteorological observations for the purpose of, 1st. determining laws: 2d. keeping, and under

proper regulations suffering to be inspected, standard instruments: 3d. making and recording observations, in number and with a regularity not to be expected, and scarcely ever obtained, in observatories maintained by individuals. Private stationary observations were next noticed, and suggestions thrown out; and lastly, traveling observations.

A report was then read, on the application of a portion of the sum of £50, voted in 1839, for discussion of *tide observations*, and placed at the disposal of Rev. W. Whewell. The subject has been diligently prosecuted during the year, and is still in progress.

Sir David Brewster gave in his report on the *hourly meteorological observations* made at Kingussie, (N. lat. 57°; W. lon. 4°,) and at Inverness, (N. lat. 57° 29½′; W. lon. 4⅓°.) Having selected Inverness and Kingussie as two suitable stations for carrying out two series of hourly observations with the thermometer and barometer, and having prevailed upon Rev. Mr. Rutherford, of Kingussie, and Mr. Thomas Mackenzie, of Inverness, to undertake the observations, the necessary instruments were made by Mr. Adie of Edinburgh, under the superintendence of Prof. Forbes, and the observations begun Nov. 1, 1838, that month being the commencement of the meteorological year, or the first of the group of winter months. I have now the satisfaction of laying before the Association the observations themselves, forming two quarto volumes,—a work of stupendous labor, executed for the first time, by educated individuals, with the aid of properly instructed assistants. The observations made at Kingussie, and to a certain extent those made at Inverness, contain ampler details of meteorological phenomena than any series of hourly observations with which we are acquainted. In addition to the thermometrical observations, the height of the barometer, and the temperature of the mercurial column were observed every hour. The general character of the weather was carefully noted. The character and direction of the wind at every hour was recorded. The number of hours of wind, of breeze, of calm, of rain, of snow, and of cloudy and clear weather, were regularly marked; and the number and nature of the auroræ boreales were recorded and described. When these observations are compared with those made at Leith under my superintendence for four years, with those made at Plymouth from 1832 to 1840, at the expense of

the Association, and under the able superintendence of Mr. Snow Harris, and with those made at Padua, Philadelphia and in Ceylon, we perceive very distinct traces of meteorological laws, of which no idea had been previously formed; and I have no hesitation in stating that when observations of this class are multiplied and extended, they will lead to general results of as great importance in predetermining atmospherical changes, as those which have enabled the astronomer to predict the phenomena of the planetary system. * * In comparing the number of hours of calm throughout the year, it appears that they occurred when the temperature was lowest, and upon laying them down in a curve, this curve was almost exactly the reverse of that of the mean daily temperature of the year; that is, the wind, or commotion in the atmosphere, depends on and varies with the temperature. This very important and new result is confirmed in a remarkable manner by the observations of Mr. Osler at Birmingham; observations of inestimable value, which were made at the request and expense of the British Association, and exhibit more important results respecting the phenomena and laws of wind than any which have been obtained since meteorology became one of the physical sciences.

Comparative force of the wind during the twenty-four hours. Mr. Follett Osler brought forward a paper in which he gave the results of his investigations respecting the direction and force of the wind, deduced from the mean of 26,000 hourly observations, taken by the anemometer at the Philosophical Institution at Birmingham, during 1837, 8 and 9. In tabulating these observations, the curve obtained is found to be almost identical with that of the thermometer; not only for the whole year, but for each season. The increase in the temperature, however, precedes the rise of the wind by a short interval, until it has attained its maximum force; but as evening approaches, the wind declines more rapidly than the temperature.

Mr. Caldecott made a communication respecting an *Hourly register of Meteorological observations kept at Trevandrum*, commenced June 1, 1837, and to be continued to June 1, 1842. The observatory was erected by the Rajah of Travancore, in lat. 8° 30′ 35″ N.; lon. 5*h*. 8*m*. E. of Greenwich; 170 feet above the level of the sea, and distant from it in a direct line, about two miles. Every precaution appears to have been taken to insure

accuracy, and of the observers, (all natives of India,) Mr. C. remarks that after the first difficulty of instructing them is surmounted, their patient, diligent and temperate habits peculiarly fit them for the office here required of them, and I have always found those who have been selected for the duty full as trustworthy as any class of persons probably, to whom such observations are usually intrusted. For the two years ending June 30, 1838, the mean temperature of the station was 78°.79: the mean dew point 71°.78. The barometric registers give, by a mean of all the diurnal semi-oscillations, the following results:

Fall between	10 A. M. and	4 P. M. . .	.109 inch.
Rise "	4 P. M. and	10 A. M. . .	.108 "
Fall "	10 A. M. and	4 A. M. . .	.071 "
Rise "	4 A. M. and	10 A. M. . .	.073 "

Times of *maxima*, between the hours of 9 and 10 morning and evening. Times of *minima*, between those of 3 and 4 afternoon and morning.

Mr. Scott Russell read the report of the *Committee on Waves.* All the objects confided to this committee, (consisting of Sir John Robinson and himself,) having been fully accomplished, the report now presented was to be considered as final. That part of the duties of the committee which related to the connexion of the phenomena of waves with the resistance of fluids to solids, had devolved upon them under a separate name, as the committee on *forms of vessels*, and would be reported under a separate head. The wave form of vessel, however, had been now proved to possess so many advantages, that its use seemed likely to become general, and thus a great change would be effected in naval architecture. Prof. Kelland read a communication on the theory of waves.—Sir D. Brewster communicated a paper on Prof. Powell's measures of the indices of refraction for the lines G and H in the spectrum; and Prof. Powell one on an experiment of interference of light.

On a blue sun seen at Bermuda. Sir D. Brewster communicated a letter from Lieut. Col. Reid, governor of the Bermudas, covering a letter from Dr. A. W. Harvey, of Bermuda, who states that on the 11th and 12th August, 1831, immediately after a hurricane which devastated Barbadoes, the sun appeared of a bluish color, and its light was unusually dim. This was owing, as Sir D. Brewster imagined, to the interposition between the sun and

the observer, of vapor or water in a vesicular state. Col. Reid's letter also contains the following statement: "Three days ago (i. e. Aug. 14, 1839) I had a fine opportunity of observing a water-spout under my house, and could with a spy-glass distinctly observe, that *at the surface of the sea* it was revolving like the hands of a watch, and the same observation was made at a telegraph station near the government house. This is the fifth account, well authenticated, in north latitude: all five revolved the same way."

On the decomposition of glass, by Sir D. Brewster.—There is no subject more curious or more instructive than the disintegration of crystallized and uncrystallized bodies, either by the direct influence of chemical agents, or the slow process of natural decomposition. At the meeting at Edinburgh, I submitted, (said Sir D.) a brief account (since enlarged and published in the Edinburgh Transactions,) of remarkable optical phenomena produced by the instantaneous action of water and other fluids on crystals, and on their subsequent decomposition when placed in their saturated solutions. Since that time I have had occasion to examine the phenomena of decomposed glass, both of that which is found in Italy, and of specimens recently found in making excavations among the ruins of the Chapter-house of the Cathedral of St. Andrews. In decomposed glass, the decomposition commences in points, and extends itself either in planes so as to form thin films, or in concentric coats so as to form concentric films. When the centres of decomposition are near each other, the concentric films or strata which they form interfere with each other, or rather unite, and the effect of this is, that the glass is decomposed in films of considerable irregularity, their surfaces having a finely mammillated appearance convex on one side and concave on the other. The films thus formed, afford by transmitted light colors of infinite beauty and variety, surpassing any thing produced in works of art. They have the effect of dissecting, as it were, the compound surface of the solar prism, or of sifting and separating the superimposed colors, in a manner analogous to what is produced by colored and absorbing media. I have succeeded indeed, in producing one or more bands of white light incapable of decomposition by the prism; and there can be no doubt that they will be found to exercise a similar or an analogous action on the leading rays of the thermometric spectrum. In the decomposed

glass from St. Andrews, a change of a very different kind is effected. In some cases the siliceous and the metallic elements of the glass are separated in a very singular manner, the particles of silex having released themselves from the state of constraint produced by fusion and subsequent cooling, and arranged themselves circularly round the centre of decomposition; while the metallic particles, which are opake, have done the same thing in circles alternating with the circles of the siliceous particles. This restoration of the silex to its crystalline state, is proved by its giving the colors of polarized light, and possessing an axis of double refraction. The most valuable glass articles manufactured by Fraünhofer, of Munich, seemed to be peculiarly liable to some superficial decomposition of this kind. A prism of this glass in the Observatory of Paris had become absolutely black. A prism belonging to himself had become quite blue on the surface, although as yet its action on light was not affected. The largest object glass of the principal telescope in the Observatory of Edinburgh had begun to show decided symptoms of superficial decomposition, and many other instances could also be mentioned. M. Lamont, professor of astronomy at Munich, who is in the constant habit of using Fraünhofer's glasses, stated that there is an easy and effectual remedy for this tendency of Fraünhofer's glass to deteriorate on the surface, which was to rub it frequently with the finer parts of whiting, prepared by elaborating a mass of whiting in water, the fine powder to be dried and used on old soft linen.

On the *rings of Polarized Light produced in specimens of decomposed glass;* by Sir D. Brewster.—In the course of a series of experiments on the connexion between the absorption of light and the colors of thin plates, published in the Phil. Trans. 1837, I accidentally observed under the polarizing microscope, certain phenomena of polarized tints of great beauty and singularity. These tints were sometimes linear and sometimes circular, and in some specimens they formed beautiful circular rings traversed by a black cross, resembling the phenomena of mineral crystals, or those produced by rapidly cooled circular plates or cylinders of glass. Having found in the decomposed glass from St. Andrews, that the siliceous particles had resumed their position as regular crystals, and arranged themselves circularly round the centre of decomposition, I was led to suppose that this was the cause of the

phenomenon, and that the rings were the effect of the double refraction of the minute crystals. A few experiments, however, overturned this hypothesis, and I was soon satisfied, by a little further investigation, that the phenomena arose wholly from the polarization of the transmitted light by *refraction*, the splendid colors being entirely those of thin plates, which were sometimes arranged so as to have the appearance of concentric rings. The structure by which these effects was produced, was compared by the author to a heap of very deep watch glasses laid one above another. When the thin films were arranged longitudinally, and were inclined to the general surface of the plate, so as to transmit the rays obliquely, the light was still polarized, but only in one plane, viz. a plane perpendicular to the plane of incidence. When a drop of *water* or *oil* was introduced between the films, the phenomena of *polarization* as well as of color, instantly disappeared.

Prof. Phillips communicated *new experimental researches on rain*. He had endeavored, by a new train of researches on the quantities of rain received on horizontal surfaces, at different heights above the ground, and by a contemporaneous series of experiments on the direction and angle of inclination of the descending lines of rain drops, and by contemporaneous registration of wind, temperature and moisture, to furnish additional data of importance in the theory of rain. In the second part of his communication he described a new rain-gauge, for the purpose of determining the direction in which rain comes, and the angle of inclination at which it descends. For this object, a compound gauge is constructed, having five equal receiving funnels and tubes; one with a vertical tube and horizontal aperture, the other four with tubes recurved, so as to present the openings of the funnels in four vertical planes, directed to four quarters of the horizon.

Excessive rain.—Prof. Forbes remarked that some doubt had been expressed concerning the remarkable fall of rain at Genoa (not Geneva,) stated in his report of the previous year, viz. 30 inches in 24 hours, Oct. 25, 1822. He now adduced satisfactory proof of its truth. He then noticed some other remarkable falls of rain. Flaugergues, the eminent meteorologist of Viviers, obtained, on the 6th of September, 1801, 14¾ English inches of rain in eighteen hours. On the 20th of May, 1827, there fell at Ge-

neva, six inches of rain in three hours. At Perth, Aug. 3d, 1829, there fell 4-5ths of an inch in half an hour. Don Antonio Lago observed at San Luis, Maranham ($2\frac{1}{2}°$ S. lat.) a fall of 23 feet 4 inches 9.7 lines in a year.

Mr. Espy's paper *on Storms*, which excited much attention, was appointed for half past twelve o'clock, (Sept. 19,) and that hour having now arrived, the President called on Mr. Espy, who commenced by stating that he had found by examining simultaneous observations in the middle of storms, and all round their borders, that the wind blows inward on all sides of a storm towards its central parts; towards a point if the storm is round, and towards a line, if the storm is oblong, extending through its longest diameter. Mr. Espy stated that he had been able to investigate within the last five years seventeen storms, without discovering one exception to the general rule. He could now only give a specimen of the manner in which he had proceeded. He presented a map of Great Britain, on which were drawn arrows representing the course of the wind on the night of January 6th, 1839. From this and from documents which Mr. Espy proceeded to read, it appeared that during those hours the wind was blowing a violent gale on the northwestern part of the island from the N. W.; on the southwestern parts from the S. W., and on the southeastern parts a strong gale from the S. E. and S. S. E.; and that in the middle parts of the island it changed from southeasterly to southwesterly about those same hours:—the change taking place about two hours sooner on the west side of the island than on the east side in the central parts, but much sooner in the northern parts than in the southern. The barometer also fell sooner in the northern and western parts than in the southern and eastern. From these two circumstances he thinks it highly probable, that this storm moved not exactly toward the east, but a little south of east, and if so, it would be similar to some storms which he had examined in the United States. He mentioned one in particular, which occurred January 26, 1839, whose N. N. E. and S. S. W. diameter reached at least seven hundred miles, while its diameter from W. N. W. to E. S. E. was probably not more than 300. The south border of this storm certainly travelled towards the south of east, and Mr. Espy found that in this storm, as in many others, the barometer fell sooner to the north and west than to the south and east. A much greater difference

however depended on the longitude than on the latitude of places. The barometer was at its minimum at Cape Wrath, in the N. N. W. corner of Scotland, two hours and a half sooner than at the Calf of Man, five hours sooner than at Edinburgh, and thirteen hours and a half sooner than at Thwaite, in Suffolk. Mr. Espy then stated that he had examined the data furnished by Col. Reid, of several hurricanes in the West Indies, and found conclusive evidence that the wind blew inwards to a central space in all these storms. Diagrams of two were exhibited :—one on the 3d of October, 1780, in which Savannah-la-Mar was destroyed. In that storm, at its very height, the wind at Savannah-la-Mar, on the south side of the island of Jamaica, was south,—and nearly opposite to that point, on the north side of the island, the wind was N. E., or nearly in an opposite direction, for two hours at the time of the greatest violence of the storm at both places. The other storm was on the 18th of August, 1837, off Charleston, S. E. On that day, the ship *Duke of Manchester* had the centre of the storm pass over her, and on the same day, the *West Indian* and the *Rawlins*, which were on the southwest of the *Duke of Manchester*, had the wind all day from 2 A. M. southwest, and at the same time the *Cicero* and the *Yolof*, on the N. E. of the Duke of Manchester, had the wind N. E. and E. N. E. The *Yolof* all day, till 8 P. M. Mr. Espy then stated that he had visited the tracks of eighteen tornadoes, and examined several of them with great care, and found that all the phenomena told one tale,—the inward motion of the air to the centre of the inverted cone of cloud as it passed along the surface of the earth. From all these facts he demonstrated that there is an inward motion of the air towards the centre of storms from all sides; and that this is the inference which ought to be drawn from the well-known fact, that the barometer stands lower in the midst of a storm than it does all round its borders. The difficulty is, to account for the continued depression of the barometer, notwithstanding the great rush of air at the surface of the earth towards the place where the barometer stands lowest. So great did this difficulty appear to Sir J. Herschel that he stated to the British Association at Newcastle, that it appeared to him fatal to Mr. Espy's theory. It appeared to Sir John that the only way to account for the fall of the barometer was a centrifugal force in the air, arising from the whirlwind character of storms. Mr. Espy thought it probable

that the following statements had never met the eye of Sir John, or he would at least have hesitated before he gave it as his opinion, that the air could not blow in towards a common centre without causing the barometer to rise above the mean. Mr. Forth says in the second volume of the Philosophical Transactions, (abridged,) that during a great depression of the barometer, January 8, 1735, he observed that the wind in the northern parts of the island blew from the N. E., and on the southern parts of the island from the S. W. And Mr. Howard says, in a great storm of 1812, the wind on the north of the Humber blew from the E. N. E., and on the south of the Humber from the S. W. Mr. Espy then stated that he found by calculating according to well-known chemical laws, that the caloric of elasticity given out in the air in which a cloud is formed, would expand the air in the cloud about 8000 cubic feet for every cubic foot of water formed in a cloud by condensation of the vapor; and he exhibited an instrument which he called a nepheloscope, which enabled him to measure the expansion with great accuracy, and he found it to agree with the calculations made on chemical principles. He then proceeded to give an outline of his theory, premising that the numbers he should introduce were not intended to be strictly accurate, and would be subject to many corrections, one in particular, in which no notice had been taken of the specific heat of air under different pressures.*

This paper gave rise to a very interesting conversation, but from the great length of the paper itself, we can only direct attention to the leading points of the discussion. Prof. Stevelly called the attention of the Section to the fact that he had at the Edinburgh meeting in 1834, used the principle of cold, produced by rarefaction, to explain what he called the secondary formation of clouds, and thus the propagation of storms; and even assigned this rarefaction as the cause of the summer hail. He objected to the main position, however, in Mr. Espy's theory, that the *fall of temperature* caused by the expansion of any body of air rendered light by being loaded with moisture as it rose in the atmosphere, was the same as the *constituent temperature of the strata of air* into which it rose, that is, of equal tension. He

* A synopsis of Mr. Espy's philosophy of storms was published in Vol. 39, (pp. 120—132,) and we therefore omit it in this place.—*Eds.*

deduced from the numbers given by Poisson, that it was much greater; that a cloud would be colder and not hotter than the surrounding air, and therefore the violent ascending vortex calculated upon by Mr. Espy would not exist. Prof. Forbes had three objections to Mr. Espy's theory: 1st. the small funnel at the centre of a tornado, through which Mr. Espy supposed the air to rise, would be insufficient to vent all the air which would rush during a tornado, with the frightful velocity we know it to attain, through the constantly enlarging rings surrounding that central funnel, to the extent of many hundred miles. 2. As the tornado had a progressive motion, as Mr. E. admitted, it would be more difficult than Mr. E. supposed to deduce from the way in which the trees in its path were thrown, the actual course of the atmospheric particles at any instant, as each would move with a motion compounded of two motions, both varying in relative direction and magnitude. 3. All the vapor in the air would be condensed into cloud much sooner than Mr. E. supposed, and he thought it certain that the small amount of heat given out by the vapor would not suffice to expand the air in the funnel to the extent required, if Mr. Espy's views were correct. As to the question whether Mr. Redfield's and Col. Reid's theory of a whirl, or Mr. Espy's radial theory, was most accordant with fact, Mr. Osler said, that from the investigation he had given this subject, he was convinced that the centripetal action described by Mr. E. took place in most hurricanes. The particulars which he, (Mr. O.) had collected, together with the indications obtained from the anemometers at Birmingham and Plymouth, satisfied him that the action of the great storm of January 6 and 7, 1839, was not rotatory at the surface of the earth, when it passed across England. He differed, however, both from Mr. Espy and Mr. Redfield in one essential point, for he believed it would be almost impossible to have a violent hurricane without, at the same time, having both rotatory and centripetal action. A storm might very probably be generated in the first instance in the manner accounted for by Mr. Espy, or by the action of contrary currents: in the first case the rush of air toward a spot of greater or less diameter would not be perfectly uniform, owing to the varying state of the surrounding atmosphere; this together with the upward tendency of the current would, in some cases, produce a violent eddy or rotatory motion, and a whirlwind of a diameter varying with the

cause would ensue; the centripetal action would thus be immensely increased, the *whirlwind itself* demanding a vast supply of air, which would be constantly thrown off spirally upwards, and diffused over the upper atmosphere, thus causing the high state of the barometer which surrounds a storm. He further stated that he had brought his theory of the combined action of centripetal and rotatory motion before the meeting at Birmingham, and a short notice of it would be found in the reports of the Sections. If no rotatory action takes place, he believed that we merely experienced the rush of air which necessarily precedes a heavy fall of rain or thunder storm; but he believed that nothing violent enough to be called a hurricane could take place, unless a violent rotatory or whirling action be first produced, and that in many and perhaps most cases, the rotatory portion is not in contact with the earth. Mr. Arch. Smith said there was one point which must not be overlooked in any correct comparison of the rival theories. From the principle of the conservation of areas it was perfectly certain, that if a storm was caused in the manner supposed by Mr. Espy, there must be a rotation, greater or less, in the centre. Because, unless the motion of all the currents were accurately directed to one point, or at least their *moments* in a horizontal plane were equal to zero, which was infinitely improbable, a motion of rotation must be the result, as in the instance of the motion of water in a funnel cited by Mr. Espy. If the central space of comparative rest were large, the whirl might be imperceptible; but if small, as in the case of a waterspout, it must be considerable. Without embracing either theory, he thought it difficult to conceive, as he understood Mr. O. to do, the motion of rotation to be the primary, and the centripetal, (which indeed would be centrifugal,) force to be the secondary phenomenon. But it was comparatively easy to suppose the centripetal motion to be the primary phenomenon, and quite certain that if so, there must result a secondary phenomenon of rotation, of which indeed some indications appeared in Mr. Espy's maps. In making some remarks on the preceding paper, Sir D. Brewster observed, that it was impossible to form any decided opinion on the subject from the great want of well ascertained facts; and as Mr. Espy had founded his theory expressly on observations, often made by himself, it was impossible to do justice to his ingenious views until a greater number of facts had been collected.

The facts too stated by Mr. Espy were opposed to those observed by others. In the case of hurricanes or tornadoes the convergence of the aërial currents in the one theory and their rotatory motion in the other were not *observed*, but *inferred* from a number of facts; but as Mr. Espy regarded water-spouts as formed in the same manner as tornadoes, and as Col. Reid had distinctly stated, (in his letter quoted before,) that he had *actually seen*, from the government house at Bermuda, by means of a telescope, the *water-spout revolving like the hands on a dial-plate of a watch*, there could be no doubt that we were at variance about facts. This explicit and distinct *observation* of a rotatory motion, by so able and accurate an observer as Col. Reid, was worth a thousand inferences. Prof. Phillips said that he thought the statements of facts connected with tornadoes as stated in the American Journals, were more consistent with Mr. Espy's than with Mr. Redfield's theory; and Col. Reid's thinking he saw rotation in a water-spout could not invalidate the abiding evidence from uprooted forests. Mr. Espy in his reply seemed to think he had been misunderstood, and answered Prof. Forbes's objections at considerable length.

A letter dated New York, July 28, 1840, from Mr. Wm. C. Redfield to Sir J. Herschel, was communicated to the meeting. With this letter Mr. R. had sent, by the steamship *British Queen*, a map showing the direction of the wind in the great storm of December 15, 1839, at noon, with a schedule of the observations: also, a sketch of the various directions of prostrated trees, &c. found in a section of the track of the New Jersey tornado of June 19, 1835, with a statement of the observations,—furnishing some of the evidences of *rotation* found in the tract of the tornado. Unfortunately neither of these communications had reached Sir J. Herschel, and there was reason to apprehend they were lost.

Mr. C. J. Kennedy read an elaborate paper on the theory of electricity.—A communication was read by Dr. Forbes, on the mean apsidal angle of the moon's orbit.—Mr. Fox read his report on subterranean temperature. Early in 1815, Mr. Joel Lean stated to him his conviction that the high temperature observed in our mines existed in the earth itself, increasing with the depth; and shortly afterwards his brother Thos. Lean, at their request, made many experiments in Huel Abraham copper mine, of which he was the manager, in order to test the correctness of

this view. The result obtained by him tended to confirm it very unequivocally; and so did another series, made the same year in Dolcoath mine, by John Rule, Jr. one of the superintendents. Many other individuals have since at the request of Mr. F., carried on similar observations in different mines, all showing that the subterranean temperature increases in some proportion to the depth of the stratum. The tables of observations given in the Report confirm Mr. Fox's previous views, that the rate of increase is not so considerable at deeper excavations as at those which are shallower.—Mr. Eaton Hodgkinson read a paper on the temperature of the earth in the deep mines near Manchester.—Prof. Forbes made his report on the temperature and conducting powers of different strata. The results agree substantially with those reported by him last year.

Sir D. Brewster read a report on the *Phenomena and cause of muscæ volitantes.* As this paper was illustrated with several drawings, and contained minute experimental details, it is not easy to give a popular account of it. The following are the principal results. 1. In persons of all ages, and with the most perfect eyes, transparent filaments or tubes exist in the vitreous humor, and at different distances from the retina. 2. These filaments float in the vitreous humor, moving about with the motion of the head. 3. These filaments are seen by means of their shadows on the retina, and are most distinctly visible in divergent light, their shadows being bounded by fringes produced by diffraction or inflexion. 4. The real muscæ, resembling flies, are knots tied, as it were, on these filaments, and arising from sudden jerks or motions of the head, which cause the long floating filaments to overlap and run into knots. 5. By making experiments with the head in all positions, and determining the limits of the motions of the muscæ, by measuring their apparent magnitude, and producing double images of them by means of two centres of divergent light, the author was able to determine their exact place in the vitreous humor, and to ascertain the important fact that the vitreous humor in the living human eye is contained in cells of limited magnitude, which prevent any bodies which they contain from passing into any of the adjacent cells. The author concluded with the following observations: "I have dwelt thus long on the subject of *muscæ volitantes*, not only because it is an entirely new one, but also on account of its practical utility. Mr.

Mackenzie informs us that few symptoms prove so alarming to persons of a nervous habit or constitution as *muscæ volitantes*, and that they immediately suppose that they are about to lose their sight by cataract or amaurosis. The details which I have submitted to you prove that the *muscæ volitantes* have no connexion with either of those diseases, and are altogether harmless. This valuable result has been deduced from a recondite property of divergent light, which has only been developed in our own day, and which seems to have no bearing whatever of an utilitarian character; and this is but one of numerous proofs which the progress of knowledge is daily accumulating, that the most abstract and apparently transcendental truths in physical science, will sooner or later, add their tribute to supply human wants, and alleviate human sufferings. Nor has science performed one of the least important of her functions, when she enables us either in our own case or in that of others, to dispel those anxieties and fears which are the necessary offspring of ignorance and error."

Sir D. Brewster read a notice 'on the line of visible direction along the axis of vision.' In D'Alembert's memoir 'on different questions in Optics,' published in his *Opuscules Mathematiques*, tome i, he has maintained the singular opinion that distant objects, like the fixed stars, when viewed directly with both eyes, are not seen in their true direction, that is, neither in the direction of the rays which they send to the eye, nor of the line (coincident with it) drawn from the point of incidence on the retina through the centre of visible direction. The author pointed out the fallacy in D'Alembert's reasoning, and thus established in opposition to the opinion of that distinguished philosopher, the law of visible direction which he had explained at the Newcastle meeting.

Dr. Reade exhibited an experiment with an instrument which he called an *Iriscope*. A piece of black polished glass was rubbed over in part with a solution of Castile soap; as soon as it was dry, the soap was polished off with a glove, until, as far as appearances were concerned, the one part of the glass was as clean as the other. He then blew his breath on the plate through a tube about half an inch in bore, and instantly the most vivid rings of colors (resembling Nobili's) were exhibited where the breath condensed on the part of the glass which had been previously soaped: while, on the other part, the condensed breath exhibited simply the usual dead gray color.

Report of the Committee (Sir J. Herschel, Mr. Whewell, Mr. Peacock and Prof. Lloyd,) appointed to draw up plans of *scientific coöperation relating to the subject of terrestrial magnetism.* In consequence of the measures adopted as detailed in the last report of this committee, a very extensive system of corresponding magnetical observations has been organized, embracing between thirty and forty stations in various and remote parts of the globe, provided with magnetometers and every requisite instrument, and with observers carefully selected, and competent to carry out, at most, if not all the stations, a complete series of two-hourly observations, day and night, during the whole period of their remaining in activity, together with monthly term observations, at intervals of two minutes and a half. Of these observatories, that at Dublin, placed under the immediate superintendence of Prof. Lloyd, has been equipped and provided for by the praiseworthy liberality and public spirit of the University of that metropolis,—those at Toronto, the Cape of Good Hope, St. Helena, and Van Diemen's Land, as also the two itinerant observatories of the Antarctic Expedition by the British Government,—those of Madras, Simla, Sincapore and Aden, by the Hon. East India Company; to which are to be added ten stations in European and Asiatic Russia, and one at Pekin established by Russia,—two by Austria, at Prague and Milan,—two in the U. States; viz. at Philadelphia, by the Girard College, and at Cambridge by the American Academy,—one by the French government at Algiers,—one by the Prussian, at Breslau,—one by the Bavarian, at Munich,—one by the Spanish, at Cadiz,—one by the Belgian, at Brussels,—one by the Pasha of Egypt, at Cairo, and one by the Rajah of Travancore, at Trevandrum, in India. In addition to this list, it has recently also been determined, at the instance of the Royal Society, by the British Government, to provide for the performance of a series of corresponding observations, both magnetic and meteorological, at the Royal Observatory at Greenwich, under the able superintendence of the Astronomer Royal. At Hammerfest also, in Norway, negotiations have been for some time carrying on for establishing an observatory of a similar description, in which Mr. Hansteen has taken an especial interest. A great number of magnetic and other instruments available for this service, it appears have been left at Kaafiord, by M. Gaymard, acting for the "Commission Scientifique du Nord," under the direction of the French

Ministry of the Marine, all which instruments, through the efficient intervention of M. Arago, it is understood will be placed at the disposal of the observer or observers who may be appointed to conduct the observations. To complete the establishment, however, certain instruments, as well as registry-books, &c. are still requisite. The Council of the Royal Society have undertaken to supply these from the Wollaston Donation Fund.* As regards the magnetic observatory at Breslau, under the direction of M. Boguslawski, your committee have to report, that in order to secure the establishment of that station, and to place it on an equal footing with the rest, certain instruments, &c. required to be provided, for which no funds existed or could be made available on the spot, viz. a bifilar and a vertical-force magnetometer, with the requisite reading telescopes, and a set of registry-books. * * These were supplied at the expense of the Association. * * A letter from M. Boguslawski, dated July 22, 1840, announces the safe arrival of the instruments and books in question, and the consequent complete state of instrumental equipment of the Breslau observatory, expressing at the same time, his sincere thanks for the assistance accorded him. By returns from the several stations authorized by the British government, so far as yet received, it appears, that the observatories at the Cape and St. Helena might be expected to be complete and ready for the reception of the instruments in May. From Van Diemen's Land no accounts have yet been received. At Toronto, Canada, where the greatest delays and difficulties were to be expected and have been experienced, the observatory was so far advanced at the date of Mr. Riddell's last communication, as to leave no doubt of its completion in time for the regular observation of the August term.† Meanwhile, in this, as at the other stations, all observations practicable under the actual circumstances of each are made and regularly forwarded; and here your committee would espe-

* An interesting view of the existing state of knowledge respecting terrestrial magnetism, and a detailed account of the present magnificent system of magnetic observations, is contained in a paper in the (London) Quarterly Review, July, 1840, No. 131, Vol. 66.—Eds.

† On the *term days*, which begin on the Friday preceding the last Saturday in February, May, August and November, at 10*h*. P. M. *Göttingen mean time*, the magnetic observations are continued for twenty-four successive hours, at intervals of *two and a half minutes*. Similar observations are also made on the Wednesday preceding the 21st of each remaining month.—Eds.

cially call attention to the extremely remarkable phenomena exhibited at Toronto on the 29th and 30th of May, when, by great good fortune, a most superb Aurora appeared at the very time of the term observations. The phenomena of this Aurora, which was remarkable for the extent and frequency of the pulsating waves, (alluded to in the Report of the Council of the Royal Society, relating to this subject,) are very minutely and scientifically described by Mr. Riddell.* But what renders the occurrence presently interesting, is the fact, that during the whole time of the visible appearance of this aurora on the night from the 29th to the 30th, as well as for some hours previous, while it might be presumed to be in progress, though effaced by daylight, all the three magnetical instruments were thrown into a state of continual and very extraordinary disturbance. In fact, at 6*h*. 25*m*. in the morning of the 29th, the disturbance in the magnetic declination during a single minute of time carried the needle over ten minutes of arc; and during the most brilliant part of the evening's display (from 3*h*. 25*m*. Gött. m. t. to 4*h*. 35*m*.) the disturbances were such as to throw the scales of both the vertical and horizontal force magnetometers out of the field of view, and to produce a total change of declination, amounting to 1° 59′. It should also be remarked, that the greatest and most sudden disturbances were coincident with great bursts of the auroral streamers. The correspondence or want of correspondence of these deviations with the perturbations of the magnetic elements observed in Europe and elsewhere on the same day, cannot fail to prove of great interest. Should it fortunately have happened that Capt. Ross has been able to observe that term at Kerguelen's Land, which is not very far from the antipodes of Toronto, an indication will be afforded whether or not the electric streams producing the aurora are to be regarded as diverging from one magnetic pole or region, and converging to another. Your committee cannot conclude this report, without congratulating the Association and the scientific world in general on the extensive interest inspired, and the vast range of observation consequently embraced by this operation, which, so far as any accounts have

* Some notices of this auroral display have appeared in this Journal, (Vol 39, pp. 194, 383.) It was attended with a singular auroral belt, extending over head from east to west, which was seen as far eastward at least as Nantucket, and westward several hundred miles from that island.—Eds.

hitherto reached them, appear to be going on prosperously in all its parts, and to promise results fully answerable to every expectation of its promoters. Neither would they feel justified in their own eyes, were they to omit expressing their deep and grateful sense of the indefatigable personal exertions of Major Sabine throughout the whole of the progress, both in carrying on a most voluminous correspondence, in ordering, arranging and dispatching instruments, and facilitating, by constant attention and activity, those innumerable details which are involved in a combination so extensive,—a combination, which, but for those exertions, your committee are fully of opinion must have been greatly wanting in that unity of design and coöperation which now so eminently characterizes it.—Signed, on the part of the committee, J. F. W. Herschel.

The following is a list of the magnetic observatories established by the Russian government, viz. St. Petersburgh, Catharinenburgh, Barnaoul, Nertchinsk, Kazan, Nikolaieff, Tiflis, Sitka, (N. W. coast of America,) Helsingfors in Finland, and Pekin in China.

The *Astronomer Royal* announced that her Majesty's government had sanctioned the establishment of a magnetic observatory at the Royal Observatory at Greenwich. In reference to the aurora seen at Toronto, in Upper Canada, on the 29th of May, and to the magnetic perturbations by which its perturbations had been accompanied, he stated that the term day of the 29th, and 30th of May, 1840, had also been kept at the Royal Observatory at Greenwich; that an aurora was seen there also on the 29th, and that the disturbances of the declination magnetometer exceeded in any amount which had been observed there on previous occasions. Observations had for some time past, been made under his superintendence, and he had observed some remarkable auroral disturbances of the needle, when the amount of the deflection had, as well as he remembered, exceeded half a degree. The coincidence of these disturbances had not been exact; at Greenwich as in America, they had been found to occur earlier than in those places more to the east.

Dr. Lamont gave an account of the magnetic observatory at Munich, regular observations at which, were begun Aug. 1, 1840. It differs in two respects from other establishments of this kind. It is 13 feet below the earth's surface, thus affording the advan-

tage of a temperature nearly equal throughout the year. Secondly, the instruments are of unusually large dimensions, and are in all respects sufficient for the most delicate investigations.—Dr. L. gave also a general statement of the system of meteorological observations carried on in Bavaria; the results of which appear in the annual publications of the Royal Observatory of Munich.

Prof. Jacobi, of St. Petersburgh, gave a historical sketch of the laws which regulate the action of *Electro-magnetic machines.* After recounting the theoretical researches carried on by himself with the assistance of M. Lenz, he adds, "Unfortunately, I cannot here give the details either of the experiments which I have made upon a very large scale, or of the machines and apparatus of various kinds which I have constructed. The necessity of multiplying the facts or tangible results,—a necessity the more urgent, because the practical applications of this force increased so very rapidly,—this necessity I say, has not allowed me time to digest and arrange them. I will, however, particularly notice the satisfactory results of the experiments made last year with a boat of 28 feet long, and 7½ feet wide, drawing 2¾ feet of water, and carrying 14 persons, which was propelled upon the Neva at the rate of about 3 English miles in the hour. The machine, which occupied very little space, was set in motion by a battery of 64 pairs of platinum plates, each having 36 square inches of surface, and charged according to the plan of Mr. Grove, with nitric and diluted sulphuric acid. Although these results may perhaps not satisfy the exaggerated expectations of some persons, it is to be remembered that in the first year, viz. in 1838, this boat being put in motion by the same machine, and employing 320 pairs of plates, each of 36 square inches, and charged with sulphate of copper, only half this velocity was obtained. This enormous battery occupied considerable space, and the manipulation and management of it were very troublesome. The judicious changes made in the distribution of the rods, in the construction of the commutator, and lastly in the principles of the voltaic battery, have led to the successful result of the following year, 1839. We have gone thus on the Neva, more than once, and during the whole day, partly with and partly against the stream, with a party of 12 or 14 persons, and with a velocity not much less than that of the first-invented steamboat. I be-

lieve that more cannot be expected from a mechanical force, whose existence has only been known since 1834, when I made the first experiment at Königsberg, in Prussia, and only succeeded in lifting a weight of about 20 ounces, by even this electro-magnetic power.

"I must on the present occasion, confess frankly that hitherto the construction of electro-magnetic machines has been regulated in a great measure by mere trials; that even these machines constructed according to the indisputable laws established with regard to the statical effects of electro-magnets, have been found inefficient, as soon as we came to deal with motion. Being always accustomed to proceed in a legitimate manner, and feeling great regret at the irregular attempts which were being made every where, without any scientific foundation, this state of things appeared to me so unsatisfactory, that I could not but direct all my efforts to ascertain clearly the laws of these remarkable machines. I submit the formulæ relative to these laws, which appear to me to recommend themselves as much by their simplicity as by the natural manner in which they develope themselves. Let R represent all the mechanical resistances acting upon the machine, and v the uniform velocity with which it moves; we have for the power or mechanical effect, the expression $T=Rv$. Let n be the number of coils of the helix which covers the rods; z the number of the plates of the battery; B the total resistance of the galvanic circuit; E the electro-motive force; k a coefficient which depends on the arrangement of the bars, the distance of the poles, and the quality of the iron; we have then for the maximum of the mechanical effect which will be obtained, the expression,

$$\text{I.}\quad T_m=\frac{z^2E^2}{4Bk}.$$

For the velocity, which corresponds to this maximum,

$$\text{II.}\quad v=\frac{B}{kn^2}.$$

For the resistance acting upon the machine,

$$\text{III.}\quad R=\frac{n^2z^2E^2}{4B^2}.$$

Lastly for the economic effect, i. e. the duty or the mechanical effect divided by the consumption of zinc in a given time,

$$\text{IV.}\quad O=\frac{E}{2k}.$$

These formulæ may be expressed in the terms,

1. The maximum of mechanical effect which may be obtained from a machine, is proportional to the square of the number of voltaic elements, multiplied into the square of the electro-motive force, and divided by the total resistance of the voltaic circuit. There enters, moreover, into the formula, a factor which I have designated k, and which depends upon the quality of the iron, the form and disposition of the rods, and the distance between their extremities. The result is, that with reference to some other investigations, which I have made of voltaic combinations, and under similar conditions, the use of platinum, zinc, the resistance being the same, will produce an effect two or three times greater than the use of coeppr, zinc.

2. Neither the number of the coils of the helix which covers the rods, nor the diameter, or the length of the rods themselves, has any influence upon the maximum of the power. It results, therefore, that neither by adding to the length or diameter of the rods, nor by employing a greater quantity of wire, can the power be increased. There is however, this remarkable fact, that the number of coils disappears from the formula, simply because the force of the machine is in a direct ratio, and the velocity is in an inverse ratio, to the square of this number. It is thus that the number of coils, the dimensions of the rods, and the other constituent parts of an electro-magnetic machine, should be considered simply as occupying the range of the ordinary mechanisms which serve for the transmission or transformation of the velocity, without increasing the available power. So it would be possible to use, instead of the ordinary wheelwork, rods of greater or less length, or a greater or less quantity of wire, in order to establish between the force and the velocity the relation which the applications to manufacturing processes may require.

3. The mean attraction of the magnetic rods, or the pressure which the machine can exert, is proportional to the square of the current. This pressure is indicated by the galvanometer, which in this manner performs the function of the manometer of steam engines.

4. The economic effect, i. e. the duty or the available power, divided by the consumption of zinc, is a constant quantity, which is expressed most simply by the relation between the electro-motive force and the factor k, which has been previously noticed.

I may here repeat what I stated elsewhere, that by employing platinum instead of copper, the theoretical expenses may be reduced in the proportion of nearly 23 to 14.

5. The consumption of zinc, which takes place while the machine is at rest, and does no work at all, is double that which occurs while it is producing the maximum of power.

I consider that there will not be much difficulty in determining with sufficient precision, the duty of one pound of zinc, by its transformation into the sulphate, in the same manner that in the steam engine, the duty of one bushel of coal serves as a measure to estimate the effect of different combinations. The future use and application of electro-magnetic machines appear to me quite certain, especially as the mere trials and vague ideas which have hitherto prevailed in the construction of these machines, have now at length yielded to the precise and definite laws which are conformable to the general laws which nature is accustomed to observe with strictness, whenever the question of effects and their causes arises. In viewing on the one hand a chemical effect, and on the other a mechanical effect, the intermediate term scarcely presents itself at first. In the present case, it is magneto-electricity, the admirable discovery of Faraday, which we should consider as the regulating power, or as it may be styled, the logic of electro-magnetic machines.

Prof. Kelland read a paper having for its object to point out the state of our experimental knowledge of the transmission of heat, and to exhibit its total inadequacy to serve as the test of any precise and accurate theory.

Dr. Anderson made a communication concerning the *meteorology of Perth*. This place is about 30 feet above the mean level of the ocean, in lat. 56° 23′ 40″ N.; lon. 3° 26′ 20″ W. The magnetic variation there, (which seemed to have reached its maximum in 1815,) was 26° 54′ W. in Nov. 1836: the magnetic dip was 72° 10′ in May, 1838. The mean barometrical pressure deduced from a period of consecutive observations, continued from 1829 to 1835, was 29.802 in., the time of observation being nine o'clock in the morning. The extreme range of the barometer during this period was 2.821 inches. The mean temperature is about 48° F. The mean annual quantity of rain from 1829 to 1834 was 30.89 inches.

Sir D. Brewster read a paper on the cause of the *increase of color in objects seen with the head inverted.* It has been long known to all artists and tourists, that the colors of external objects, and particularly of natural scenery, are greatly augmented by viewing them with the head bent down and looking backwards between the feet, that is, by the inversion of the head. The colors of the western sky, and the blue and purple tints of distant mountain scenery are thus beautifully developed. This position of the head is a very inconvenient one; but the effect may be produced nearly to the same extent by inverting the head so far as to look at the landscape backwards beneath the thighs or left arm. It is not easy to describe this change of color, but it may be stated that the colors of distant mountains, which appear tame and of a French gray color when viewed with the head erect, appear of a brilliant blue or purple tint with the head inverted. * * While in perplexity about the cause of the phenomenon in question, I had an opportunity of observing the great increase of light which took place in an eye in a state of inflammation. This increase was such, that objects seen by the sound eye appeared as if illuminated by twilight, while those seen by the inflamed eye, seemed as if they were illuminated by the direct rays of the sun. All colored objects had the intensity of their colors proportionally augmented; and I was thus led to believe that the increase of color produced by the partial or total inversion of the head, arose from the increased quantity of blood thrown into the vessels or the eye-ball,—the increased pressure thus produced upon the retina, and from the increased sensibility thus given to the sentient membrane. Subsequent observations have confirmed this opinion, and though I cannot pretend to have demonstrated it, I have no hesitation in expressing it as my conviction that the apparent increase of tint to which I have referred, is not an optical, but a physiological phenomenon. If this is the case, we are furnished with a principle which may enable us not only to appreciate faint tints, which cannot otherwise be recognized, but to perceive small objects which, with our best telescopes, might be otherwise invisible.

Mr. Snow Harris's report on the working of Whewell's anemometer at Plymouth, was read by the secretary. The instrument being now effectively at work, Mr. H. proposes to have completed by the next meeting a graphical delineation of the in-

tegral amount of wind shown by it at Plymouth for the entire year, and in the mean time he sent drawings and tables which contain the results of its work for the last three months.

Sir David Brewster then offered some remarks on microscopes, and his mode of illuminating microscopic objects.

Prof. Nichol gave an account of the astronomical observatory erecting near Glasgow. Two reflectors by Ramage had been obtained, one of 25 feet focal length, to which Sir J. Herschel's collimator is to be affixed, and another of 55 feet focal length and 23 inches in diameter. A transit-circle had been been ordered from Munich, the telescope of which is 8 feet focal length and 6.25 inches diameter. An equatorial of great power was also in expectation.

Mr. Airy, the astronomer royal, gave an explanation of a new apparent polarity of light, announced some time since by Sir D. Brewster. His explanation resulted in showing that the phenomenon is a simple consequence of the undulatory theory. Sir D. Brewster remarked that Prof. Powell's solution of this problem was fallacious, and that of Mr. Airy did not explain all the facts. A full account of experiments on the phenomenon in question is now preparing for the Royal Society.

Sir D. Brewster gave an account of a rainbow seen in Dumfriesshire by Rev. Mr. Fisher, in which the primary bow was accompanied with *five* supplementary bows, and the secondary one with *three;* a larger number than had been before noticed.

Mr. Airy explained the principles of Mr. Fowler's new calculating machine, the object of which was to facilitate the guardians of a poor-law district in Devonshire, in calculating the proportions in which the several divisions were to be assessed.

Dr. Anderson then submitted some observations on the dew point, in which he explained the principles of the formula which he deduced several years ago, from the experiments of Dalton and Gay-Lussac, for determining the various objects connected with the hygrometric state of the air; and showed by means of tables which he had constructed from it, the facility and dispatch with which the absolute as well as the relative humidity of the atmosphere, together with the dew point, might be obtained.

Mr. Shand read a paper on the agency of sound, adverting to the rules and principles by which it is governed, and with particular reference to the economy of voice in public apartments.

Mr. Graham Hutchinson read a paper on a method of prognosticating the probable mean temperature of the several winter months, from that of corresponding months in the preceding summer.

Mr. Wm. Bald continued a series of observations made in 1839, and 1840, on the tides in the harbor of Glasgow, and the velocity of the Tidal Wave in the estuary of the river Clyde, between Glasgow and Port Glasgow.

[*The remainder is unavoidably deferred to the next number.*]

ART. IX.—*Abstract of a Meteorological Journal for the year* 1840, *kept at Marietta, Ohio, Lat.* 39° 25′ *N., and Lon.* 4° 28′ *W. of Washington City;* by S. P. HILDRETH, M. D.

Months.	THERMOMETER.				Fair days.	Cloudy days.	Rain and melted snow.		Prevailing winds.	BAROMETER.		
	Mean temperature.	Maximum.	Minimum.	Range.			Inches.	100ths.		Maximum.	Minimum.	Range.
January,	25.00	43	−4	47	11	20	2	33	W., N. W.	29.80	28.78	1.02
February,	41.00	74	−0	74	15	14	3	08	W., S. W., S. E.	29.75	28.88	.87
March,	48.66	78	16	62	12	19	3	21	W., N., S. E.	29.64	28 82	.82
April,	56.57	88	26	62	17	13	4	25	S. W., N., S. E.	29.74	29.10	.64
May,	61.80	91	33	58	21	10	5	21	S., S. E.	29.55	28.92	.63
June,	68.66	89	43	46	19	11	4	25	S., S. W.	29.68	29.10	.58
July,	71.25	92	51	41	23	8	2	17	S., S. W.	29.63	29.25	.38
August,	72.43	90	51	39	22	9	5	25	S., S. W.	29.65	29.20	.45
September,	57.27	82	34	48	20	10	2	00	S., S. E., N.	29.75	29.12	.63
October,	52.83	82	19	63	19	12	3	92	S. W., W., N. W.	29.60	29.08	.52
November,	40.60	68	22	46	14	16	1	92	W., S. W.	29.70	28.88	.82
December,	32.14	58	6	52	11	20	1	50	W., N. W.	29 75	28.85	.90
Mean,	52.55				204	162	39	09				

Remarks on the year 1840.—The mean temperature for the year is 52.35°, which varies but a small portion of a degree from that of the preceding year. The amount of rain and melted snow is 39.09 inches, which is a few inches below the annual mean for this place, but is about six inches greater than that of the preceding year. The distribution has been regulated in a remarkable manner, so as to be most abundant in those months, where the heat and evaporation are the greatest, and moisture most needed for the growth of plants and filling out the ripening grain. The mean temperature for the several seasons is as follows.—N. B. The winter embraces December of 1839.

Winter months, 34.11°. Spring months, 55.70°. Summer months, 70.85°. Autumn months, 50.24°. There is a great similarity in the seasons of the two past years, the difference being not more than a degree in any one of them. The range of the barometer has been less than in the preceding year, the mercury rising at no time higher than 29.80, or sinking below 28.78. January was a very cold month, the mean being 25°, which is ten degrees below that of 1839. Although the mercury did not fall at any time to more than 4° below zero, yet it was below and near to that point on ten mornings. February, which is usually the coldest month, was this year six degrees warmer than January. March was six degrees warmer than that of last year, and brought forward the blooming of plants somewhat earlier. The past year in the west, has been somewhat remarkable for storms of wind and hail. On the 23d of April, at half past four P. M., a tornado swept across the S. E. portion of the town of Marietta, near the Ohio river, unroofing several buildings, and blowing down the brick gable ends; quite a number of ornamental trees were prostrated. It crossed the Ohio from Virginia, where it did considerable damage to fences, trees, &c. The force of the wind continued only for a few minutes, and was not very extensive. On the third day of May, a similar tornado visited Gallipolis and vicinity, doing considerable damage to buildings, trees and fences. It took place at half past four P. M. The same gust reached Marietta at half past five, but was not so violent.

Gallipolis lies about sixty miles distant in a S. W. direction from Marietta. On the 18th of June, about noon, an uncommon shower of hail fell upon a district of country three miles south of this place. It commenced in the state of Ohio, a few miles west of the river, ranging nearly east and west, and crossed the river into Virginia, passing over the large island below town. It was about a mile in width, and eight or ten miles in length. A constant discharge of electric fluid attended the shower, not however, in very loud peals of thunder, but with a continual roar, like the rumbling of carriages over hard ground. So immense was the quantity of hail, that it covered the earth to the depth of six or eight inches, destroying the wheat, rye and oats, entirely, beating them into the ground. Indian corn was greatly damaged, but made a tolerable crop, where the plants were trim-

med carefully with a knife and set upright. Apples and peaches, half grown, were torn with the leaves, from the trees, presenting a very dismal appearance. A man who was plowing corn on the island, took shelter under an apple tree, thinking it only a common shower. He was bare-footed and bare-legged, and in his shirt sleeves. The hail covered his feet above the ankles, and nearly froze them before he could reach the shelter of a deserted building that stood near the field. Sheep, fowls, and small animals suffered severely from the effects of the hail. At Marietta, the cloud discharged rain principally, with a few scattering hail-stones. The wind was light at the time, or the damage must have been much greater. Large quantities of the unmelted hail remained until the next day. It had quite an effect on the temperature at Marietta, as the mercury, which stood at 68° in the morning, sunk to 62° at 2 o'clock P. M., while the day before, it was at 80°, and the day following, at 76° at the same hour.

Flowering of plants and trees, ripening of fruit &c., in 1840.—March 1, Mezereon in bloom; 2, white maple, and red elm; 18, early hyacinths; 20, daffodil and dew-drop; April 2, Pyrus japonicus; 3, peach and white-heart cherry begin to open; 4, damson; 5, imperial gage; 7, peach in full bloom; 8, winter, or pound-pear—puccoon and anemone; 10, service tree; 11, Judas tree, or red-bud; 13, apple nearly open; 16, apple in full bloom, early tulips open; 19, Cornus florida, or dog-wood; 21, tree peony, papaveracea, quince tree; 22, tulips in full bloom, apple shedding its blossoms; 25, lily of the valley, yellow mocason flower, or Cypripedium parviflorum; 27, Anona glabra; May 2, yellow single rose; 5, Isabella and Catawba grape; 6, a smart frost, which destroyed many of the grape blossoms; 14, black walnut, Rubus villosa, or black-berry; 17, white rose, and white Chinese peony, for which latter flower the rose-bugs have an especial liking; 22, many varieties of hardy roses in bloom; 25, Gladiolus, and Pæonia fragrans; 26, peas fit for the table, some years they are six or eight days earlier; 27, pine-apple strawberry ripe; June 6, white lily in bloom; 13, early Russian cucumber fit for the table, grown without artificial heat; 14, red Antwerp raspberry ripe; 17, Lilium Pennsylvanicum in bloom; 19, blight in pear and quince trees, worse than ever before known, nearly destroying trees of fifteen years growth; 20, rye

harvest begun; 27, chandler apple ripe; July 2, wheat harvest begun; 14, Vaccinium frondosum, or whortleberry, ripe, grows on the hills, amongst the yellow pine; 15, Rubus villosus, or blackberry ripe.

Columba migratoria.—The forest trees generally, this year abounded with fruit, being what is called in the west, "a fine year for mast." In such seasons, we are generally visited with immense flocks of the Columba migratoria, or wood pigeon. This year they appeared about the 15th of September, filling the woods with their numbers. One of their "roosts" was selected about a mile and a half from Marietta, in the uplands, where the timber was a second growth; the trees generally small, and many of them mere saplings. From near sunset to an hour after, the air was filled with their winged squadrons, and the trees and bushes loaded with pigeons, seeking a resting place for the night. They found it however, a very unquiet one, for the young men and boys visited them every night with torches of pine wood, killing them with shot guns, and knocking many down with sticks, until they were tired with the sport. After about two weeks, the pigeons shifted their nocturnal camping ground, either from the disturbance of the hunters, or to a more plentiful region for food. The "roost" covered a space of several hundred acres, so that their numbers must have amounted to many millions. Between daylight and sunrise, they uniformly visited the shore of the Ohio river, for drink, or for small gravel stones to assist in digesting. At this period, the vigilant sportsman had fine amusement in shooting them on the wing, as they rose over the top of the bank where he was standing, killing sometimes two or three dozen at a single discharge. Although this beautiful bird has been subject to the depredation of man for more than fifty years in Ohio, in addition to the multitudes that annually fall a prey to their feathered enemies, they still exist in vast numbers. What then must have been the amount of their winged hosts, as they yearly migrated from the warm regions of the south, to the cooler districts of the north, as instinct and habit directed, before civilization had made any inroads on the vast forests which had for ages supplied them with food.

Marietta, January 5th, 1841.

ART. X.—*Contributions towards a History of the Star-Showers of Former Times;* communicated by EDWARD C. HERRICK, Rec. Sec. of the Conn. Acad.

[Read before the Connecticut Academy of Arts and Sciences, April 28, 1840; and since revised.]

A FULL account of the showers of shooting stars which have visited our planet, would much enlarge our knowledge of the system of bodies from which we receive these brilliant strangers. But a mere catalogue even, of all these displays is too much to hope for, inasmuch as some of them have doubtless been concealed by clouds, and others witnessed only by barbarians. Of those which have been preserved by the historian, a complete collection cannot at present be made in this country, owing to the insufficiency of our means of historical inquiry. A large portion of the materials for the present paper was collected in a search which I made in 1837 and 1838, for the purpose of obtaining evidence of the annual occurrence in August of an unusual number of shooting stars. The publication of the paper has been delayed in the hope that it might be rendered less incomplete; but I have now concluded to offer it in its present state, trusting that those who have the opportunity, will supply its deficiencies and correct its errors.*

(1.) 1768 *years before Christ.* "In the fiftieth year of the reign of the emperor Kié or Li-Koué, i. e. the year 1768 [before Christ] the Chinese saw stars falling:" [des étoiles tomber.]—*Cométographie par M. Pingré,* Paris, 1783, t. 1, p. 248, 4to.; quoted from the *Monarchiæ Sinicæ Synopsis Chronologica,* annexed to Vol. 2, of *Voyages* de Mel. Thévenot, Paris, 1696.

This statement is quite indefinite, and I cite it with some hesitation. The most probable meaning seems to be that a large number of shooting stars was seen; but it remains to be determined whether the original record warrants the construction here assumed.

(2.) 686 B. C. In the reign of the Emperor Le-wang, B. C. 686, "the stars disappeared, and meteors fell like rain."—*Medhurst's China,* London, 1838, 8vo. App. No. 1, p. 570.

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* A partial list of the dates of these meteoric showers, was given in Vol. XXXIV, p. 182, and also in Vol. XXXV, p. 367.

This at first view appears to be a very clear case, but its resemblance to an instance mentioned in the Catalogue of Bolides, &c. observed in China, (Abel-Rémusat, Jour. de Phys. 1819,) which reads thus—"687 *ans avant J. C.* * * *les étoiles ne paroissoient pas,* * * *il tomba une étoile en forme de pluie,*"—induces the suspicion that the Chinese annalist may mean to state only the appearance of a single meteor which exploded into fragments. See note under No. (6.)

(3.) A. D. 7. "In the thirty sixth year of his reign, [i. e. of Synin who began to reign in the year of Synmu 632, before Christ 29 years,] it rain'd Stars from Heaven, in Japan."—*Hist. of Japan, by Engelb. Kæmpfer, M. D.*, trans. by J. G. Scheuchzer, London, 1728, folio, Vol. 1, p. 162.*

(4.) A. D. 532. "In the same year [A. D. 532] there happened a great chasing of stars from evening until morning, so that every one was amazed, and cried out—The stars are falling! We never knew any thing like it!"

"Τῷ δ' αὐτῷ ἔτει καὶ ἀστέρων γέγονε δρόμος πολὺς ἀπὸ ἑσπέρας ἕως αὐγους· ὥστε πάντας ἐκπλήττεσθαι, καὶ λέγειν, ὅτι οἱ ἀστέρες πίπτουσι, καὶ οὐκ οἴδαμεν ποτὲ τοιοῦτο πρᾶγμα."—*Theophanis Chronographia: Hist. Byzant. Script. Corp.* ed. Venet. fol. 1729, tom. 6, p. 126.

The following account of the same event is given by Cedrenus: "In the same year there was a great running of stars, so that all were astonished, and exclaimed—See! the stars are falling! We don't know what is to happen."—*Geo. Cedreni Comp. Hist.;* Hist. Byz. Sc. Corp. tom. 7, p. 292.—Stated also in Jo. Malalæ Chronog. l. 18, p. 477, cons. B. G. Niehbuhr, Bonnæ, 8vo. 1838.

This is the shower referred to A. D. 533, in Chladni's *Feuer-Meteore*, p. 88.†

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* In the same work are the two following accounts, which may perhaps relate to meteoric showers.

A. D. 11. "In the 40th year of his reign, [i. e. of Synin,] on a clear and serene day, there arose of a sudden in China, a violent storm of thunder and lightning: Comets, *Fiery-Dragons and uncommon Meteors appeared in the Air, and it rain'd fire from Heaven.*" p. 163.

A. D. 771. "In the second year of his reign, [i. e. of Koonin,] there happened a storm of thunder and lightning dreadful beyond expression. *It rained fire from Heaven, like stars,* and the air was filled with a frightful noise." p. 175.

† In E. H. Burritt's *Geography of the Heavens,* (5th ed. 1838, 12mo.) p. 161, it is said that "as early as the year 472, in the month of November, a phenomenon of this kind [a shower of shooting stars] took place near Constantinople. As Theophanes relates, 'the sky appeared to be on fire with the coruscations of the flying meteors.'" This is a mistake. It was a shower of volcanic dust from Vesuvius.

(5.) **A. D. 558.** "Some time after this, there was a great running of stars from evening until morning, so that every one was greatly terrified, and exclaimed,—'the stars are falling.'"

"*Μετὰ δὲ χρόνον τινὰ, γέγονεν ἀστέρων δρόμος ἀφ' ἑσπέρας ἕως πρωΐ, ὥστε πάντας ὑπερεκπλήττεσθαι καὶ λέγειν, ὅτι πίπτουσιν οἱ ἀστέρες.*"—*Geo. Cedreni Compend. Historiarum;* Hist. Byz. Sc. Corp. tom. 7, p. 304.

(6.) **A. D. 585.** "In the 8th moon, on the day Ou-chin [September 4?] there appeared many hundred shooting stars scattering themselves on all sides."

"A la 8e lune, le jour Ou-chin, il parut plusieurs centaines d'étoiles coulantes qui tombèrent en se dispersant de tous côtés."—*Catalogue des Bolides et des Aérolithes observés à la Chine, etc. tiré des livres Chinois, par M. Abel-Rémusat: Jour. de Phys.* 1819, t. 88, p. 356.*

(7.) **A. D. 611.** A shower of shooting stars is referred to by Sojuty, as having occurred this year. See No. (29.)

(8.) **A. D. 744 or 747.** "And the stars came forth shooting exceedingly."

"And steorran foran swythe scotienda."—*Chron. Saxonicum,* edit. Gibson, 4to. Oxon. 1692, p. 55.

(9.) **A. D. 750.** "At that time happened a fearful sight and a strange portent resulting from an appearance in the sky. It began about candle-lighting and was visible during the whole night, causing surprise and great fear in all the beholders. For

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* This Catalogue is derived chiefly from the compilation of a Chinese author, Ma-tou-an-lin, who has given a chronological account of fire-balls, meteorites, &c. down to A. D. 1221. Abel-Rémusat has generally omitted those cases where the meteor did not explode, so that it is quite probable that the original list comprises several star-showers. Some of the following instances cited by Rémusat, may perhaps prove to be such showers, but they cannot be so considered without further evidence. Some of them appear to be only single meteors which left trains of sparks.

687 B. C. En été, à la 4e lune, le jour Sin-mao (5e de la lune) les étoiles ne paroissoient pas, quoique la nuit fût claire, il tomba une étoile en forme de pluie.

15 B. C. A la 2e lune, le jour Kouei-wei, après minuit, il tomba une étoile en forme de pluie.

268 A. D. A la 7e lune, une étoile tomba en pluie du côté de l'ouest.

288 A. D. A la 8e lune, le jour Ji-tseu, nouvelle pluie d'étoiles.

532 A. D. A la 7e lune, le jour Kia-tchin, une étoile tomba en pluie.

837 A. D. A la 9e lune, le jour Ting-yeou il y eut une étoile de la grosseur d'un boisseau, etc. Plusieurs centaines de petites étoiles le suivoient.

1002 A. D. A la 9e lune, le jour Phing-chin, il y eut une étoile qui sortit de l'Orient, etc. Plusieurs dixaines de petites étoiles la suivoient et tombèrent avec elle.

it seemed to them as though all the stars left their appointed places in the heavens, and descended towards the earth. But when they came near the ground, they were one and all suddenly dissipated without doing any damage whatever. Many assert that this astonishing sight was witnessed throughout the whole world."

"*Συνηνέχθη γὰρ τηνικαῦτα θέαμα φοβερὸν καὶ τεράστιον ξένον ἐξ ἀερίου γενέσθαι συμπτώματος· ἅτερ περὶ λόχνων ἀφὰς κατάρξαν, διὰ πάσης ἐφαίνετο νυκτὸς, ἔκπληξιν καὶ δέος μέγα τοῖς θεωμένοις ἐμποιοῦν ἅπασιν. Ἐδόκει γὰρ αὐτοῖς ὡς οἱ ἀστέρες ἅπαντες τοῦ τεταγμένου αὐτοῖς οὐρανίου χώρου παρ* • • • *ιούμενοι κατὰ γῆς ἐφέροντο. Οἱ δὲ περίγειοι γενόμενοι ἀθρόον διελύοντο, ἥκιστα τὴν οἰανοῦν βλάβην ποιησάμενοι πώποτε. Φασὶ δὲ πολλοὶ ὡς διὰ πάσης τῆς οἰκουμένης τὸ τοιοῦτον ἐξαίσιον διεδεικνύετο θέαμα.*"—*Sancti Nicephori Patr. Constantinop. Breviarium Hist:* Hist. Byz. Scr. Corp. tom. 7, p. 33.

(10.) A. D. 764. "In the same year, in the month of March, stars were seen falling from heaven, so that all the beholders imagined that the end of the world had come. There was also a great drought, and the fountains were dried up."

"*Τῷ δ' αὐτῷ ἔτει μηνὶ Μαρτίῳ ἀστέρες ἐκ τοῦ οὐρανοῦ πίπτοντες ὤφθησαν, ὡς πάντας τοὺς ὁρῶντας τὴν τοῦ παρόντος αἰῶνος ὑπολαμβάνειν εἶναι συντέλειαν· αὐχμός τε πολὺς γέγονεν, ὡς ξηρανθῆναι καὶ πηγάς.*"—*Stephanis Chronographia:* Hist. Byz. Scr. Corp. tom. 6, p. 291.—See also *Hist. Miscellæ*, lib. 22, Muratori: Rer. Ital. Scr. tom. 1, p. 159:—*Calvisii Opus Chronol.* fol. 1685, p. 634.

This is the shower referred to A. D. 763, in Chaldni's *Feuer-Meteore*, p. 88.

(11.) A. D. 765. "On Saturday, the fourth day of January, A. D. 765, stars were seen falling as it were from heaven."

"Anno 1076, [Græcorum; Christi 765,] mense Canun posteriori, (Januario,) die 4, feria 6, stellæ quasi e cœlo decidere visæ sunt."—*Dionysius Patriarcha, in Assemanni Biblioth. Orient.*, tom. 2, p. 112. Romæ, 1721, folio.*

(12.) A. D. 829. "An Earthquake at Aix a few Days before Easter, and a violent Hurricane. Another Comet in Aries. And for several Days together, very many little twinkling Fires like Stars, ran up and down in the Air; great Tempests of Wind followed. *Chr. Magdeb.—General Chronological History of the*

* In the Saxon Chronicle, under date of A. D. 793, it is stated that *fiery dragons* [a common term for very brilliant meteoric fire-balls,] *were seen flying through the air.* It does not appear whether they were numerous.

Air, Weather, &c. [by Dr. Thos. Short.] 2 vols. 8vo. Lond. 1749. Vol. I, p. 86.

This account is not altogether intelligible, and I have not been able to find any other testimony concerning the occurrence.

(13.) A. D. 855. October 17. "This year there was a fall of stars during the night preceding the first day of the month Djomadi II, (Hegira 241,) which continued from the beginning of the night until dawn. At the same period earthquakes were felt in all parts of the world."

"Dans cette année (savoir 241) il arriva une chute d'étoiles dans la nuit (c'est-à dire qui précéde le jeudi) dans la nouvelle lune, (le premier quartier,) du Dschumadi II, et qui dura depuis le commencement de la nuit jusqu'à l'aurore. Il y eut en même temps des tremblements de terre dans le monde entier."—*Tarich el-Mansury, Cod.* 521. *Acad. Sci. fol.* 51; *cited by M. Fraehn, in a communication to the Imp. Acad. Sci. of St. Petersburgh, Dec.* 1, 1837; *quoted in L'Institut, Paris, No.* 252, *p.* 350. *Oct.* 25, 1838.

(14.) A. D. 899. November 14. "In the year 286 (of the Hegira,) there was an earthquake in Egypt, on Wednesday, the 7th of the month Djolkaada, from midnight until morning, and the stars called Schuhub, (luminous meteors,) were in extraordinary commotion, going from east to west, and from north to south, in such a manner that no mortal could look at the heavens."

"Dans l'année 286, il y eut en Egypte, un tremblement de terre le mercredi 7 du mois de Sulkade, depuis le milieu de la nuit jusqu'au matin, et les étoiles qu'on nomme Schuhub, (i. e. le météore lumineux) s'agitèrent d'une manière extraordinaire en se mouvant de l'est á l'ouest et du nord au sud, de façon qu'aucun mortel ne pouvait jeter les yeux sur le ciel."—*Elmacini Histor. Saracen., Arab. et Lat., op. Erpenii*, p. 181, *quoted by M. Fraehn, L'Institut*, No. 252, p. 350.

(15.) A. D. 901. "The whole hemisphere was filled with those meteors called falling stars, the ninth of Dhu'lhajja, (288th year of the Hegira,) [A. D. 901, November 25,] from midnight till morning, to the great surprise of the beholders, in Egypt."—*Modern Part of the Universal History.* 8vo. Vol. 2, p. 281. Lond. 1780.

(16.) A. D. 902. "In the month Djolkaada of the year 289, (of the Hegira,) died king Ibrahim ben Ahmet, and during the same

night were seen great numbers of stars, which moved, as if they had been darted through the atmosphere, from a culminating point, and rushed down on the right and left, like rain. On account of this phenomenon, this year was called the year of stars."

"Dans la lune Dylcada de l'année 289, mourut le roi Ibrahim ben Ahmet, et dans le même nuit, on vit un nombre considérable d'étoiles, qui comme si elles eussent été lancées dans les airs, partaient d'un point culminant et se précipitaient à droite et à gauche sous forme de pluie. C'est à cause de ce phénomène que cette annèe a pris le nom d'*Année des étoiles.*" *Conde: Hist. de la Domination des Maures en Espagne*, I, 397, *quoted by M. Fraehn*, (as above,) *who states that the date is the 24th or 25th October*, A. D. 902. *First quoted in part by Von Hammer*, Comptes Rend. Acad. Sci., 1837, I, 293.

The following probably refers to the same occurrence: "Anno Dominicæ Incarnationis 902, urbs Tauromenis a Sarracenis capta est. Eodem anno in nocte visi sunt igniculi in modum stellarum per aera discurrentes: qua nocte Rex Africæ residens super Cosentiam Calabriæ civitatem, Dei judicio, mortuus est."—*Chronicon Romualdi II, Archiepisc. Salernitani:* in *Muratori, Rer. Ital. Scr.* t. vii, p. 160.

(17.) A. D. 912 or 913. "I will here add what I have seen in a commentator on the Astronomical Aphorisms of Ptolemy, the last of which begins thus: 'Shooting stars indicate dryness of the air; if they all go towards the same quarter of the heavens, they foreshow winds which will blow from that quarter, but if they scatter in all parts of the heavens they indicate the drying up of the water, disturbances in the atmosphere, and the incursions of armies moving in various directions.' The commentator remarks, 'I remember that in the year 290 [of the Hegira, beginning Dec. 4, A. D. 902] there were seen in Egypt burning meteors which scattered themselves through the sky and filled the whole expanse; they caused great terror and increased continually.* A short time after, a great dearth of water was felt in this country: the Nile rose only thirteen cubits, and violent disturbances arose which caused the ruin of the dynasty of the Toulounis in Egypt. In the year 300 [beginning Aug. 17, A. D. 912] the same phenomena were seen in all parts of the sky; the flow

* If the dates are correct, this must be a case different from No. (16.)

of the Nile was bad, and there were troubles and agitations in the country.' These are doubtless very strong signs, but they are common to all regions; and not peculiar to Egypt. We have seen a recurrence of the same phenomena in the present year 596, [beginning Oct. 22, 1199.] At the beginning of the year, the stars were seen coursing through the heavens, and afterward the water was very low. During the same year the sovereign of Egypt was dethroned by his uncle Melic-aladel."—Translated from "*Relation de l'Egypte, par Abd-allatif, médecin Arabe de Bagdad, etc.; traduit et enrichi de notes historiques et critiques: par M. Silvestre De Sacy.*" Paris, 1810, 4to. book 2, chap. 2, p. 340. *First quoted in part by M. Fraehn*, (sup.)

The passages occur at pp. 117 and 118 of the Tubingen edition of 1789.

(18.) A. D. 931 or 934. "In the same year appeared signs in the heavens among the stars, which appeared some falling and others blazing like torches, on the fourteenth day of October, the second day of the moon."

"934. Indictione 4. Defunctus est Joannes Abbas II Kal. Aprilis, fer. 2. Et in ipso Anno apparuerunt signa in Cœlo de stellis, quæ videbantur hominibus aliæ cadere, aliæ fulgere sicut faculæ XIV die intrante mense Octobri Luna 2."—*Notes found on a Calendar; and printed at the end of Chronicon Cavense:* Muratori, Rerum Italicarum Scriptores. 26 tom. fol. Mediol. 1723, etc. t. vii, p. 961.

The date on the margin is A. D. 934. The year of the Indiction requires A. D. 931: the moon's age agrees about equally well with either.

(19.) A. D. 935. In the year 323, [Hegira,] "several violent shocks of an earthquake were felt in Egypt, the third of Dhu'l-kaada: [Oct. 5, A. D. 935,] about the same time, many of those meteors called falling stars, of a very remarkable kind, likewise appeared in Egypt."—*Modern Part of the Universal History.* 8vo. Lond. Vol. 2. 1780. p. 333. (*Hist. of the Arabs.*)

The following is cited by M. Fraehn: "Le 3 du Sulkade de l'an 323, il y eut en Egypte, un tremblement de terre, et les étoiles lumineuses étaient dans un mouvement violent."—*Eutychii Annal.*, II, 529.

It is plain that the exact date of the shower cannot be inferred from either of these accounts.

(20.) A. D. 1029. "In the year 420, in the month Radjab, [beginning July 16, A. D. 1029,] fell many stars with great noise and very vivid light."

"Dans l'an 420, au mois de Redscheb, il tomba beaucoup d' étoiles, avec accompagnement d'un bruit extraordinaire et de lumières tres vives."—*Soyuti, Hist. Cair. fol.* 338. *First quoted by Von Hammer: Comptes Rend.* 1837, I, p. 293. *Cited also by M. Fraehn.*

Was this a shower of shooting stars, or only the fall of a number of meteoric stones?

(21.) A. D. 1060. In the *Comptes Rendus* of the French Academy of Sciences, (1837, I, 532,) it is stated that M. de Paravey had found in an ancient history of Anjou, an account of a remarkable fall of shooting stars which happened A. D. 1060. The date of the month was not mentioned in the history. It is to be hoped that the passage will be given in full.

(22.) A. D. 1090. "M. Muncke states that in the year 1090, according to the chronicles of that period, shooting stars appeared in considerable numbers, during several consecutive nights."—Trans. *from M. Quetelet's Catalogue des Principales Apparitions d'Etoiles Filantes:* (Brux. 1839,) p. 28; *where reference is made to Gehler's Dict. of Physics*, viii, 1025.

This may possibly be a typographical error for A. D. 1096.

(23.) A. D. 1094. "At this period, so many stars fell from heaven that they could not be counted. In France the inhabitants were amazed to see one of them of great size, fall to the earth, and they poured water on the spot, when to their exceeding astonishment, smoke issued from the ground with a hissing noise."

"A. D. 1094. Rex autem Willielmus [Victor] omnes fines Walliæ hostiliter ingressus * * * Eodem tempore tot stellæ de cœlo cadere visæ sunt, quòd non poterant numerari. Inter quas, cum unam magnam quidem labi in Gallia gens stuperet, notatoque loco, aquam ibi fudisset, fumum cum stridoris sono de terra exire, obstupuit vehementer."—*Matth. Paris Mon. Alb. Angli Hist. major*, etc. fol. Lond. 1640, p. 18.

"The year 1094 was very remarkable for the number and fashion of gliding stars, which seemed to dash together in manner of a conflict."—*Sir J. Hayward, cited in Guthrie's History of England.* fol. 1744. Vol. i, p. 423.

It is not improbable that these events belong to the next year.

(24.) A. D. 1095. April 4. "This year Easter was on the 8th of the Kalends of April. And, after Easter, on the festival of St. Ambrose, that is on the 2d of the Nones [4th day,] of April, over almost all this land and for nearly the whole of the night, stars were seen falling from heaven in manifold ways, not one or two at a time, but so thickly that no man could count them."

"MXCV. On thisum geare wæron Eastron on VIII kl. Apr. And tha uppon Eastron on sce Ambrosius mæsse-niht, that is II Non. Apr., wæs gesewen for-neah ofer eall this land swilce for-neah ealle tha niht swithe mæni-fealdlice steorran of heofenan feollan, naht be anan oththe twam, ac swa thiclice thæt hit nan mann ateallan ne mihte."—*Chron. Sax. ed. Gibson.* Oxon. 1692. 4to. p. 202.

This instance was first quoted, anonymously, from Wilken's History of the Crusades, (*Geschichte der Kreuzzüge*, Leipzig, 1807,) in Comptes Rendus Acad. Sci. (1836, II, 145.) Wilken (th. 1, s. 75,) quotes Baldric's Chronicle, which states that the shooting stars were on that occasion so numerous, "ut grando, nisi lucerent, pro densitate putarentur." The date is erroneously given, April *twenty fifth*, in Wilken. It is thus copied into the Comptes Rendus, from which work the false date has been extensively propagated. Calvisius (Opus Chronolog., etc. fol. Franc. ad Mœn. 1685, p. 743,) also gives the subjoined quotation from Baldric, which shows the origin of the mistake. The moon was in fact in the twenty fifth day of the lunation, on the 4th day of the month of April of that year. Notices of this great meteoric shower are found in many different authors, some of which are given below. Its exact date is most satisfactorily determined.

"1095. Stellæ in cœlo die 4. April. fer. 4, Lunâ 25, visæ sunt inter se pugnare, in tanta frequentia, ut numerari non possent."—*Baldricus.*

"Anno autem Dominicæ Incarnationis millesimo nonagesimo quinto, Indictione tertia, pridie Nonas Aprilis, quartâ feriâ post octavas Paschæ, à quarta ferme vigilia noctis, usque in crepusculum, stellæ innumerabiles de cœlo, versus occidentalem plagam, ubiq. terrarum cadere visæ sunt."—*Chron. Sac. Monast. Casin.;* in Muratori *Rer. Ital. Scr.* t. iv, p. 497.

1094 ["verius 1095"] Ind. II. mense Aprilis Urbanus Papa Placentiæ Synodum celebravit et IV Nonas ejusdem mensis Aprilis fuit terribile signum in stellis, ita quòd a mediæ noctis tempore usque

manè visæ sunt innumeræ stellæ mixtim ex omni parte Cœli decurrisse, et in terram decidisse.—*Romualdi Salern. Chron.*, in Muratori, *Rer. It. Scr.* t. vii, p. 177.

Anno 1095, mense Aprilis in nocte diei 4, subito visi sunt igniculi cadere de cœlo, quasi stellæ per totam Apuliam, qui repleverunt universam superficiem terræ, et ex tunc cœperunt Galliæ populi, imò totius Italiæ pergere ad sepulchrum Domini cum armis ferentes in humero dextro Crucis signum.—*Lupi Protospatæ Rer. in Reg. Neapol. Gest. Chron.*, in Muratori, *Rer. It. Scr.* t. v, p. 47.

1095. Pridie Nonas Aprilis visæ sunt in nocte stellæ, quasi de cœlo cadere.—Rog. de Hovenden, *Annales, pars prior.* fol. Lond. 1596. fol. 266.

(25.) 1096. "During many nights stars were seen to rain down at intervals, but so thick and fast, that one would have said they were flakes from the celestial orbs."

"On vit durant plusieurs nuits pleuvoir des Etoiles par intervales, mais si dru et menu, qu'on eût dit que c'étoient des bluettes du débris des orbes célestes."—*De Mezeray: Abrégé Chronologique de l'Hist. de France.* Amst. 1755. 4to. t. ii, p. 156.

"In 1096 nono [Qu. nonis] Aprilis in Depositione Sancti Ambrosii, [Aprilis 4?] visæ fuerunt in multis locis frequenter in illa nocte stellæ, quæ ceciderunt de cœlo, et in Ascensione Domini, quæ fuit in illo et eodem anno, et in festivitate Sancti Ambrosii cecidit magna nix."—*Chron. Parmense*, in Muratori, *Rer. It. Scr.* t. ix, p. 760.

Chladni has mentioned the meteors of this year, (*Feuer-Meteore*, pp. 88, 89,) referring for authority to *Historiæ francicæ fragmentum;* in Duchesne: *Hist. Franc. Script.* t. iv, p. 90.*

(26.) A. D. 1106. "On the twelfth of February, at Bari, a town in Italy, were seen by day several stars in the sky, sometimes apparently running together, and sometimes apparently falling to the earth."

"Pridie idus Februarii apud Barum Italiæ oppidum conspectæ sunt aliquot stellæ in cœlo per diem, nunc quasi inter sese concurrentes, nunc quasi in terram cadentes."—*Hist. Eccl. Magdeb.* tom. vi, p. 1712.

* In (Short's) *Genl. Chr. Hist. of the Air*, &c., it is said that in A. D. 1099, "many frightful prodigies were seen: * * * stars seemed to fall to the earth, &c." Vol. 1, p. 104.

"A comet was visible in February, from 3 o'clock to 9 for twenty five days at the same hour. * * * In Judea this comet was seen fifty days decreasing. * * * Shortly after the Stars seemed to rain down from Heaven."—*Clark's Mirrour.*—[*Short's*] *Gen. Chron. Hist.* of the Air, &c. Vol. I, p. 107.

The following passage (nearly identical with that above given,) is quoted from Schnurrer's *Die Krankheiten des Menschengeschlechts*, 1825, (Bd. 1, s. 230,) by M. A. Erman, in *Poggendorff's Annalen der Physik*, B. 48, s. 585, (1839.)

"Anno 1106, pridie Idus Februar. apud Baram Italiæ stellæ visæ sunt in cœlo per diem, nunc quasi inter se concurrentes, nunc quasi in terram cadentes."

The foregoing is cited by Erman in support of his hypothesis that the meteoric stream from which are derived the shooting stars which at the present time are seen about the 10th of August, intervenes between the earth and sun about the 6th of February. The account does indeed seem to assert that the meteors were seen in the day time, but it is evident that unless they were at least as brilliant as the planet Venus, they would not be visible in such circumstances. There was no eclipse of the sun on this day. Perhaps the story may be cleared up by reference to the *Annales Boicorum* of Aventinus, from which many fearful prodigies are quoted in the Magdeburgh Ecclesiastical History, as happening at this time. Without the quotation from *Clark's Mirrour*, it would be doubtful whether the number of meteors seen at this time was larger than usual.

(27.) A. D. 1122. April 4. In the year of our Lord 1122, on the day before the nones of April, at the fourth watch of the night, while the brethren were chanting the Synaxis nocturnalis, innumerable stars were seen falling, and as it were raining down, throughout the world."

"Hoc interea tempore, anno Dominicæ Incarnationis ejus millesimo centesimo vicesimo secundo, pridie Nonas Aprilis, quarta vigilia noctis, cum Fratres nocturnalem Synaxim decantarent, stellæ de Cœlo innumerabiles cadere, et quasi pluere visæ sunt, ubique per totum orbem terrarum."—*Chronica Sacri Monasterii Casinensis*, lib. 4, cap. lxxix, in Muratori, *Rer. It. Scr.* t. iv, p. 546.

1122. Stellæ innumeræ quasi pluere visæ sunt pridie Non. Aprilis horâ matutinâ.—*Anonymi Monachi Cassinensis Breve Chronicon;* in Muratori, *Rer. It. Scr.* t. v, p. 61.

1122. Indictione decimaquinta Stellæ innumerabiles visæ sunt cadere per totum orbem pridie .... Aprilis hora matutina.—*Chron. Fossæ Novæ*, in Muratori, *Rer. It. Scr.* t. vii, p. 868.

(28.) A. D. 1199. "At the beginning of the year [596 of the Hegira, commencing Oct. 22, 1199] the stars were seen coursing through the heavens, &c." See quotation from Abd-allatif's Account of Egypt, under No. (17.)

(29.) A. D. 1202. In the year 599, on the night preceding Sunday the last day of the month Moharrem, [October 19, A. D. 1202,] the stars rushed across the heavens from east to west, and glided to the right and left, like grasshoppers in a field. This continued until dawn. The inhabitants cried out with terror, and fervently implored the mercy of the Most High. A similar occurrence happened in the year of the holy mission of the Prophet, [A. D. 611,] as well as in the year 241, [A. D. 855.]

"En l'an 599, dans la nuit du dimanche, dans le dernier jour du Muharrem, les étoiles s'élancèrent au ciel dans une direction de l'est à l'ouest, et s'échappèrent ça et la tant à droite qu'à gauche, comme des sauterelles sur un champ. Ceci dura jusqu'à l'aurore. Les hommes jetèrent des cris d'épouvante et implorèrent à grand cris la misericorde du Tres-Haut. La même chose, au reste, avait eu lieu dans l'année de la sainte mission du Prophète, ainsi que dans l'année 241."—*Soyuty's Hist. of Cairo*, fol. 342, *quoted by M. Fraehn*, (as above.) *First cited in part by Von Hammer, Comptes Ren. Acad. Sci.* 1837, I, 294.

"Au commencement de l'an 599 on vit à Bagdad les étoiles tomber çà et là, et comme des sauterelles s'élancer d'un lieu dans un autre. Celá dura jusqu'à l'aurore. Les hommes poussèrent des cris et implorèrent par des prières le Dieu tout puissant."—*Scheby, in T. Duwel el-Islam. Cod. Acad. Sci.* No. 254. *Cited by M. Fraehn.*

"Dans l'année 599 on vit un mouvement d'oscillation des étoiles pendant toute la nuit du dernier [jour] de Muharrem."—*Haddschy Chalfa, Chronological Tables. Cited by M. Fraehn. L'Institut*, No. 252.

(30.) A. D. 1243, July 26. "In this year, on the 7th of the Kalends of August, the night was most serene and the air exceedingly pure, so that the milky way was as manifest as in the clearest winter night, although the moon was in her eighth day. And to our surprise, stars were seen falling from heaven, swiftly

darting on all sides. * * * Most remarkably, thirty or forty were seen to shoot or fall at the same instant, so that two or three would fly together in the same track. Of course, if these had been real stars, (which no man of sense supposes,) not one would have been left in the sky. It belongs to the astrologers to interpret this portentous appearance; but to all the beholders it was a most stupendous and wonderful spectacle."

"Et eodem anno, videlicet septimo Calend. Augusti, fuit nox serenissima, aërque purissimus, ita quòd Lactea, sicut solet placidissima nocte hyemali contingere, manifestè apparebat, Luna existente octava. Et ecce stellæ cadere de cœlo videbantur, velociter sese jaculantes hac et illac. Non tamen, ut de more contingit, quædam faculæ per modum stellarum subruentes (quod, sicut determinatum est in libro Metheorum *Aristotelis*, naturaliter contingit,) sicut fulgur ex tonitru: sed in uno instanti, præter solitum, triginta vel quadraginta saltitare vel cadere viderentur, ita scilicet, quòd duæ vel tres simul uno tramite, volare se mentirentur. Unde, si veræ stellæ fuissent (quod nullius sapientis est sentire) nec una in cœlo remansisset. Considerent Astrologi, quid hujusmodi portentum significet; sed omnibus intuentibus, videbatur nimis stupendum et prodigiosum.*—*Matt. Paris Mon. Alb. Angli Hist. Major.* fol. Lond. 1640, p. 602.

"1243. Eodem mense [i. e. Julii] discursus Siderum de nocte visus est in Festo Sancti Jacobi [26to.] ita ut unum contra alterum quasi hostem insurgerent, et inter se hostiliter dimicarent." —*Ric. de St. Germano Chronicon*, in Muratori, *Rer. It. Scr.* t. vii, p. 1052.

(31.) A. D. 1366, Oct. 22. "In the year 1366, on the day after the festival of the eleven thousand virgins, [Oct. 22,] from midnight until daylight, stars were seen falling in streams from heaven, and in such multitudes that no man could count them."

"Eodem anno (i. e. 1366) die sequenti post festum XI millia virginum, ab hora matutina usque ad horam primam† visæ sunt quasi stellæ de cœlo cadere continua [continue ?] et in tanta multitudine, quod nemo narrare sufficit."—*Chronicon Ecclesiæ Pra-*

* This quotation was published in my paper of November, 1837, (this Jour. Vol. 33, p. 358.)

† The hour of *matins* ranged between midnight and one o'clock in the morning; the *prime* began at day break or sometimes at sunrise. There is no reason to suppose that this display was seen in the day time.

gensis.—Script. Rer. Bohem. pars II, p. 389. Prag. 1784. Quoted by Boguslawski, Jr. in *Poggendorff's Annalen der Physik und Chem.* B. 48, s. 612, 1839.

(32.) A. D. 1398. "Many stars of a fiery appearance fell down. At this time pestilence invaded nearly the whole of Italy."

"Anno Domini MCCCLXXXXVIII. Multæ stellæ ad modum ignis ceciderunt, quas Asub vocant. Tunc pestis totam fere Italiam invasit."—*Annales Forolivienses*, in Muratori, *Rer. It. Scr.* tom. xxii, p. 200.

(33.) A. D. 1399. "An eclipse of the sun happened on the second of the Calends of October. [Sept. 30.] Stars like fire were also seen falling from heaven in many parts of Italy."

"Anno Domini MCCCIC. Eclipsis Solis facta est secundo Calend. Octobris. Stellæ quoque instar ignis de cœlo cadentes in plerisque Italiæ locis visæ sunt."—*Annales Forolivienses*, in Muratori, *Rer. It. Scr.* t. xxii, p. 200.

(34.) A. D. 1635, 1636. "During the whole summer of 1635, no less than during that of 1636, signs of this sort were seen, viz. burning stars running together in the heavens in great numbers and falling to the earth."

"Hujus quoque generis varia signa pestem Noviomagensem prænunciare visa sunt: Tota enim æstate anni 1635, non minus quam anni 1636, hujusmodi indicia se prodiderunt: Nempe, stellarum ardentium in cœlo oberrantium magnus concursus, et in terram prolapsio."—*Diermerbroeck*: *Op. omnia.* fol. Ultraj. 1685: *De Peste*, p. 10. Quoted in *Webster's Hist. Epidem. and Pestilen. Diseases*, Vol. 2, p. 89.

If this is to be interpreted literally, it must be considered an extravagant account. In (Short's) *Gen. Chron. Hist. of the Air*, &c., is the following statement, (the time of year being uncertain,)—"From March to August, 1636, not one drop of rain. This Numigen plague raged most at new and full moon. It was presaged by great Justling and Falling of fiery Stars south or west, many fewer birds than ordinary, &c."—Vol. I, p. 314.*

* Rev. W. B. Clarke, in Loudon's Mag. Nat. Hist., 1834, Vol. 7, p. 294, states that, "On August 18, 1716, meteors were seen all over Europe, from 8 P. M. to 3 A. M."—"On January 4, 1717, there was a shower of fire at Quesnoy."—The first case is probably a display of the aurora borealis: the latter was probably a lightning-bolt, or possibly a large meteoric fire-ball.—(*Hist. de l'Acad. de France*, 1717, p. 8, II.)

(35.) A. D. 1743. October 4. "A clear Night, great Shooting of Stars between 9 and 10 a Clock, all shot from S. W. to N. E. [Qu. N. E. to S. W.] one like a comet in the Meridian very large, and like Fire, with a long broad Train of Fire after it, which lasted several minutes; after that was a Train like a Row of thick small Stars for twenty Minutes together, which dipt N."—*General Chronological Hist. of the Air, Weather, &c.* [by Dr. Thos. Short.] Lond. 1749. 8vo. Vol. II, p. 313.

The dates of the catalogue thus far, are of the Julian style: those which follow, are of the Gregorian.*

(36.) A. D. 1799. November 12. A great shower of shooting stars, seen chiefly between midnight and morning, in various parts of Europe and America. The light of the moon (then at the full,) greatly impaired the splendor of the display.—*Ellicott's Journal.* 4to. 1814. p. 248.—*Humboldt: Voyage,* tom. 4. liv. 4. ch. 10. 8vo.—*Gilbert's Ann. der Physik,* Bd. 6: 191, 12: 217, 15: 109.

(37.) A. D. 1803. April 20. A great shower of shooting stars after midnight, seen in the northern and middle portions of the United States. Sky clear and moon only a few hours before the change.—*This Jour.* Vol. 36, p. 358.†

(38.) A. D. 1832. November 13. An extensive shower of shooting stars seen between midnight and morning, in various and widely distant parts of the globe. The moon (five days past the full,) much diminished the brilliancy of the spectacle.—*Bib. Univ. de Genève.* 1832; t. 3: 189.—*Comptes Rend.* VI. 562.

(39.) A. D. 1833. November 13. A great shower of shooting stars seen between midnight and morning in various parts of

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* In this catalogue I intend to confine myself to *showers* of shooting stars, and omit many instances, occurring chiefly in August, in which meteors have been seen in uncommon, but not very large numbers. Of these meteoric displays some may perhaps merit a place in this list, e. g. those of Aug. 9, 1779, Aug. 9, 1798, Dec. 6, 1798, and Aug. 9, 1837. An extensive collection of these cases is given by M. Quetelet in his *Catalogue des Principales Apparitions des Etoiles Filantes,* (4to. Bruxelles, 1839.) It may be well to restrict the term *meteoric shower* to those instances where the meteors appear at a rate not less than 1000 per hour.

† In E. H. Burritt's *Geography of the Heavens,* (12mo. 1838, p. 161,) it is said, "a shower of stars exactly similar took place in Canada between the 3d and 4th of July, 1814, and another at Montreal, in Nov. 1819." "Another was witnessed in the autumn of 1818, in the North Sea, &c." Probably neither of these occurrences was a shower of shooting stars. On the 3d and 4th of July, 1814, there fell on the river St. Lawrence, Canada, a quantity of dust or ashes, the air being very hazy and smoky.—*Tilloch's Phil. Mag.* Lond. 44: 91. That of 1818, was doubtless a display of the aurora borealis.

North America. The meteors appeared to diverge from the vicinity of *γ Leonis*, and were most abundant about 4 A. M. Sky clear and moon in the second day past the change.—*This Jour.* Vols. 25, 26, &c.

Recapitulation: dates reduced to Gregorian style.

1.	B. C.	1768.	14.	A. D.	899. Nov. 18.	27.	A. D. 1122. April 11.
2.	"	686.	15.	"	901. Nov. 30.	28.	" 1199. Oct. ?
3.	A. D.	7.	16.	"	902. Oct. 30.	29.	" 1202. Oct. 26.
4.	"	532.	17.	"	912 or 913.	30.	" 1243. Aug. 2.
5.	"	558.	18.	"	931 or 934. Oct. 19.	31.	" 1366. Oct. 30.
6.	"	585. Sept. 6?	19.	"	935. Oct. ?	32.	" 1398.
7.	"	611.	20.	"	1029. July or Aug.	33.	" 1399. Oct. ?
8.	"	744 or 747.	21.	"	1060.	34.	" 1635, 1636.
9.	"	750.	22.	"	1090.	35.	" 1743. Oct. 15.
10.	"	764.? March.	23.	"	1094.	36.	" 1799. Nov. 12.
11.	"	765. Jan. 8.	24.	"	1095. April 10.	37.	" 1803. April 20.
12.	"	829.	25.	"	1096. April 10?	38.	" 1832. Nov. 13.
13.	"	855. Oct. 21.	26.	"	1106. Feb. 19.	39.	" 1833. Nov. 13.

The limits prescribed to this paper will permit only a very brief discussion of the preceding catalogue. The region of country included by these showers, down to that of A. D. 1799, extends from England to China, about 130° in longitude, and from about 20° to 51° N. latitude. The table above shows the dates (whenever they could be found,) reduced to the Gregorian calendar, which, thus stated, will indicate with sufficient accuracy the point of the earth's orbit, in each instance intersected by the meteoric stream. It is reasonable to presume that some of the dates are erroneous, and that some of the cases were not actually meteoric *showers*. Much caution is therefore necessary in tracing the correspondence of dates between these ancient star-showers and those of the present age, especially as our knowledge is so imperfect regarding the meteoric seasons which now exist. The shower of April 20, 1803, may be the lineal successor of those of April 10, 1095 and 1122. That of August 2, 1243, may be the ancestor of the meteoric sprinklings of August 10, seen at the present day. It does not appear certain which of these ancient showers is represented by the modern shower of November 13. There is some reason to suppose that those showers which are described as continuing all night, (e. g. Nos. 4, 5, 9,) may have occurred in the summer season.

Previous to 1833, we have no precise observations on the position of the point of *radiation* during any meteoric shower, but

some slight indications that such radiant was noticed, occur in Nos. 14, 16, 29, 35. No comparison as to this particular can be made between the ancient and the modern meteoric displays.*

If the foregoing catalogue comprised all the star-showers that have ever occurred, it would be easy to determine the *cycle* of the shower of any particular date. In the present state of our knowledge, it may be inferred that the cycle of the November shower is about *thirty four* years. There is of course some ground for expecting about the year 1867, a recurrence of the splendid displays of November 13, 1832 and 1833. It is remarkable that Humboldt mentions that the earthquakes of 1766 in South America, were preceded by phenomena like those of November 12, 1799. I have searched several American newspapers of the former period, but find no trace of any such meteoric display in the United States. The cycle of the April shower may be about *twenty seven* years; but it does not appear that any unusual number of meteors was seen in April, 1830. It is, however, not to be supposed that the cycle remains constant through successive ages.

A just theory of shooting stars must explain all the meteoric showers enumerated in the foregoing list, so far as they are truly stated. It must likewise account for all the meteoric seasons which exist at the present time, and also for the shooting stars of daily occurrence, which, taking into view the whole globe, are exceedingly numerous. The most probable hypothesis is, that there are revolving around the sun, millions of small planetary and nebulous bodies, of various magnitudes and densities; and that when any of these dart through our atmosphere, they become ignited and are seen as *shooting stars*. To ascertain the mode in which they are arranged in the solar system, is an important object of inquiry. A *single* zone or ring of such bodies is insufficient to account for all the known phenomena.

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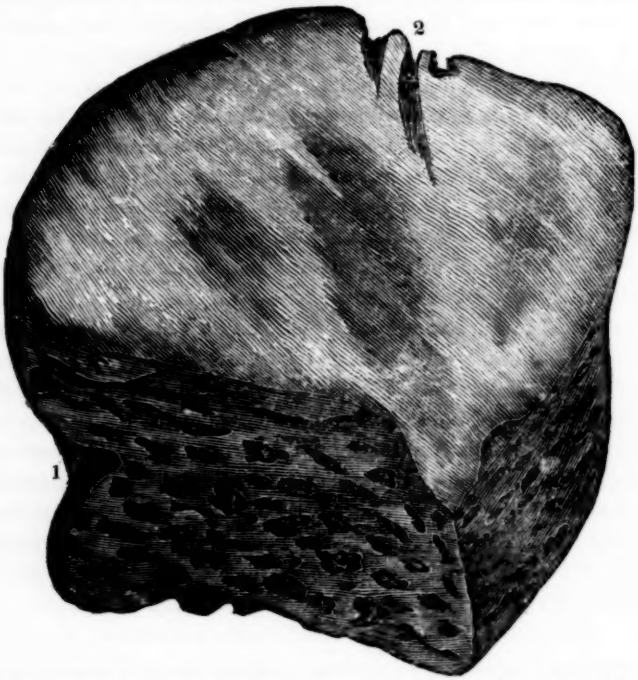
* The following passage from Ptolemy (differing somewhat from that quoted under No. 17,) deserves notice here, as showing that observations upon the directions of shooting stars were not unknown in his time.—"Discursiones et jaculationes stellarum si ab uno angulo prorumpant, inde quoque ventum emittunt. Sin occurrant inter se, ventorumque prælia suscitant. Sin vero de quatuor plagis ruant, hyemes varias ferunt, atque etiam fulmina, tonitrua, et quæ alia hujusmodi sunt."—*Claud. Ptol. lib. de judiciis, interp. J. Camerario*, fol. Basil. 1551, p. 403.

ART. XI.—*On Native and Meteoric Iron;* by CHARLES UPHAM SHEPARD, M. D., Professor of Chemistry in the Medical College of the State of South Carolina.

Native Iron from near Oswego, N. Y.

WHILE at French Creek, Jefferson county, N. Y., during the last summer, I was informed by Capt. HUGERNIN, of that place, of the existence of a mass of native iron at Oswego, which had for several years been in the possession of an individual there, by whom it had been preserved, under the impression that it was



of meteoric origin. Aided by directions from Capt. H., I had no difficulty, when passing through Oswego a few days after, in finding the person in whose hands the specimen was still remaining. This individual was Mr. PHILANDER RATHBUN, a highly intelligent and respectable blacksmith. He very liberally presented me the mass, upon the conditions of my devoting to it a careful examination, and reserving for him a slice of it, suffi-

ciently large to enable him to gratify the very rational curiosity he possessed of working under the hammer, an iron which he was satisfied differed very considerably from the metallic iron of the arts.

The mass was found in the town of Scriba, four miles east of Oswego, about five years ago, by a man by the name of Julius Rust, who was in the habit of furnishing Mr. RATHBUN with charcoal. It was discovered in digging up the soil, which had been the foundation of an old coal-pit. Its weight is about eight pounds; and its general aspect, of which some idea may be formed by the annexed figure, is wholly opposed to the supposition of its being a product of the forge. Indeed no iron works of any description have ever existed in this region. It approaches the cube in shape, though all its angles and edges are more or less rounded, while its upper surface is sub-spherical, and nearly smooth. The sides and base, on the contrary, are much pitted by irregular concavities, which give a surface most resembling on the whole, the ripple produced on a calm sea by the first access of a gentle breeze. The arrangement of these depressions and elevations upon the sides of the mass, is such, as to give obscure lines or waves parallel to the edges of the base. This appearance taken along with the more flattened shape of the base, led Mr. RATHBUN to imagine that the mass had fallen from the heavens, in a plastic condition, and that its present figure is partly accounted for, by its striking the earth on that side, which is here described as the base.

With the exception of a few impressions made in two or three places by the cold chisel, for the purpose of detaching little fragments by Mr. R. there is no trace pertaining to it, of any human workmanship. But its most singular feature consists in its having several re-entering angles, (see 1 and 2,) about its edges, which are closely packed with a hard, black and brittle ore, whose color and lustre approach to those of Borrowdale plumbago. No part of the specimen exhibited any accumulation of rust. Its color, where a fresh surface had not been exposed, was iron-black. The fresh surface is light steel-grey. The texture is exceedingly fine, and when polished, the lustre is high.

On my return to New Haven, I employed a skilful machinist, who had been accustomed to the slitting of meteoric iron, to make a number of sections from one side of the mass. In per-

forming this operation, he observed that its hardness was less in amount, and more uniform in its nature, than that of the Texian meteoric iron, while it differed no less strikingly in other respects, from any artificial iron with which he was acquainted. He noticed in particular, that it possessed an unusual degree of toughness. Its specific gravity is 7.50.

Ammonia was added in excess to the slightly warmed, nitro-hydrochloric solution of this iron, and the fluid shortly after cleared from the precipitated sesquioxide of iron: this fluid was destitute of any tinge of blue, nor did it yield a precipitate when treated with the hydrosulphate of ammonia. Neither nickel or cobalt can therefore enter into the composition of this iron.

In the next place, I detached, with considerable difficulty, enough of the brittle plumbago-looking mineral above alluded to, to discover in it the following properties: hardness $=5.0\ldots5.5$: specific gravity $=5.2\ldots5.4$; brittle: color dark iron-black: streak similar, except a tinge of brown: lustre imperfectly metallic: fracture uneven to granular; a portion of it is magnetic, while the rest is not taken up by the magnet. Heated before the blowpipe, in thin fragments, it does not fuse, but becomes somewhat rounded on the edges; after heating, it is strongly magnetic. It slowly entered into solution in nitro-hydrochloric acid, excepting a few flocks of silicic acid. No traces of either nickel or cobalt were present in the solution.

It is only very recently that I have had it in my power to resume the investigation of this singular specimen of iron. I am unable to detect in it either of the following principles, to wit, lead, tin, manganese, copper, titanium, silver, sulphur or phosphorus.

The precipitated peroxide of iron, on digestion with a solution of potassa, and subsequent treatment with hydrochlorate of ammonia, gave only a faint troubling from alumina.

The clear fluid, from which the iron and alumina were precipitated, gave with oxalate of ammonia, a distinct, but feeble precipitate of oxalate of lime.

The solution of the iron in hydrochloric acid, as well as in sulphuric acid, gave an impalpable, heavy, black, plumbaginous looking matter, which on being ignited alone, suffered no change in color. It was heated to redness along with carbonate of potassa, the mass was treated with water, and hydrochloric acid, whereupon silicic acid made its appearance.

The iron afforded me the following results:

Iron, - - - - - - -	99.68
Silicon, - - - - - - -	0.20
Calcium, - - - - - - -	0.09
Aluminium, in traces, - - -	
	99.97

The hard and brittle ore attached to the mass, does not appear to differ essentially from ordinary magnetic iron ore. It contains traces of silicic acid and of lime.

The source of this iron, must probably for the present, remain a subject of doubt. The secondary country in which it was found, no less than the peculiar configuration of the mass, would lead us to doubt its terrestrial origin, either as a product of nature or of art; while the absence of nickel in its composition, separates it widely from meteoric iron. Future observations may relieve it from the isolated position it now appears to hold.

Meteoric Iron from Guilford County, North Carolina.

In the year 1830, I gave, in Vol. xvii, p. 140, of this Journal, a hasty notice of two small fragments of iron from North Carolina, which had been presented to the American Geological Society, by Prof. D. Olmsted, of Yale College. Having had occasion to bestow a renewed attention to the subject recently, I find I had adopted an erroneous opinion respecting the specimen from Guilford County. It contains both chlorine and nickel; and consequently can no longer be regarded as possessed of terrestrial origin.

The structure of this iron, as developed by the recent attempt to detach a few grains for analysis, reminds me forcibly of that exhibited by the Buncombe, (N. C.,) meteoric iron. Like this, it cleaves into tetrahedral, octahedral, and rhomboidal fragments, and presents the same foliated texture, and pinchbeck tarnish. It cleaves, however, with greater difficulty than the Buncombe iron.

In effecting its solution in nitro-hydrochloric acid, I observed a very slight residuum of a greyish black color. It was removed from the solution, and finely pulverized in a mortar. It presented the appearance of magnetic iron, and on treating it with a concentrated portion of the mixed acids, it entered into solution af-

ter the manner of this ore. Peroxide of iron was thrown down on the addition of ammonia to the solution.

Water boiled in contact with the iron, afforded, when treated with nitrate of silver, a copious precipitate of chloride of silver. Faint traces of cobalt were also detected in the iron. But the small quantity of the mineral at my command, prevented me from attempting to estimate the proportions of these ingredients. The same reason also precluded the search after other principles often found in meteoric iron. The following presents the results obtained :

Iron, - - - - - - -	92.750
Nickel, - - - - - - -	3.145
Magnetic iron? - - - -	0.750
	96.645

Charleston, S. C., Feb. 3d, 1841.

Art. XII.—*On the First, or Southern Coal Field of Pennsylvania;* by M. Carey Lea.

Among the numerous sources of wealth possessed by Pennsylvania, are her inexhaustible iron mines and coal beds. It must be acknowledged by all, that they constitute her true wealth, and they will contribute greatly to elevate her in the scale of national prosperity.

Her coal beds are peculiarly valuable, possessing as she does, every variety of this fuel, from the hardest *anthracite*, to the most highly charged *bituminous coal.* She can supply those kinds most suitable for economical purposes, for generating gas, for making and working iron, in a word, for all the many uses to which this substance is applied. It is chiefly to her mines that the steam navigation of the Atlantic coast must look for its supplies, and the quantity thus consumed, though at present it may appear inconsiderable, will probably be soon enormously increased.

It has been the opinion of my father for many years, that the hard or highly carbonized anthracite of the eastern end of the Southern Coal Field, changes to the bituminous in the western end, by nearly regular gradations, the veins probably being continuous from the one point to the other. A case analogous to this is presented by the anthracite and bituminous coal of South Wales.

With a view of testing this opinion, and for other purposes, a laborious set of analyses was undertaken, from specimens known to be authentic, in the laboratory of Prof. Booth. The method of analysis pursued was the following. One gramme of the coal, reduced to a fine powder in an agate mortar, was carefully and gradually heated, in a platina crucible having but one small aperture, in order to drive off the volatile matter. When this was effected, the residuum was weighed, and the volatile matter thus ascertained. The crucible was then exposed to the highest heat of an alcohol blowpipe for some hours, until the carbon was thoroughly burnt out, and the ash was then weighed. The ash and volatile matter subtracted from 1.000 gave, of course, the carbon.

It must be borne in mind that the analyses of the various coals from the Dauphin and Susquehanna Coal Company's lands, were made from specimens taken from explorations of veins, near the surface, and should therefore be considered in a great measure as crop coals.

*Analyses.**

No. 1. *Lehigh.*—The farthest eastern point at which coal is worked, is that owned by the Lehigh or Mauch Chunk Coal Company. The specimen of this coal examined was very pure, and of very conchoidal fracture; it was broken with difficulty and flew very much under the strokes of the pestle. Its color was a deep, brilliant black, with very narrow parallel lines of a still deeper color. It was a long time in burning and left a light fleecy ash of a very white color.

No. 2. *Tamaqua.* Little Schuylkill Coal Co.'s Mines.—This is the next important mining station, west of the Lehigh. The specimen was very brilliant with a somewhat conchoidal fracture, and so hard that white paper rubbed on a fresh fracture was scarcely marked by it. Its ash was greyish white and flocculent.

No. 3. *Pottsville.* Black Mine Vein.—Next in order is the Pottsville coal. The specimen examined was of a fine brilliant appearance and very refractory. It came from the Black Mine vein, two hundred feet below water level, and contained layers of a darker and softer substance without any splendor, and by these it usually fractured. Ash deep red.

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* The analyses have been condensed into a tabular form for greater economy of room and perspicuity; the Nos. will be found to correspond with the table.—*Eds.*

No. 4. *Pinegrove.*—A specimen of this coal, from the "North Seam," three fourths of a mile north of Sharp Mountain, was submitted to examination. It was brilliant, exhibited a conchoidal fracture, and was refractory under the hammer. Ash reddish yellow.

No. 5. *Black Spring Gap*, 26 miles from the Susquehanna. Fish-back Vein.—This is the next western point at which coal is worked, and from it, specimens of two veins were examined, this and the following. This one is devoid of lustre, and after burning, leaves a yellowish red ash.

No. 6. *Black Spring Gap.* Peacock Vein.—The coal from this vein was brilliant, with a conchoidal fracture, and leaves a yellowish red, very light ash.

No. 7. *Gold Mine Gap*, 25 miles from the Susquehanna. Peacock Vein.—This coal is brilliant, possessing a conchoidal fracture. Its ash was yellowish red, very bulky and light.

No. 8. *Rausch Gap*, 21 miles from the Susquehanna. Pitch Vein, west side.—The specimen from this vein was rather friable. Its fracture was somewhat conchoidal, and generally brilliant. Ash yellowish red.

No. 9. *Rausch Gap.* Pitch Vein, east side.—This coal is hard and rather brilliant, leaving a deep red ash, which changes to yellowish brown by a day's exposure to the air.

It will be seen that the portions of volatile matter in the two last are very nearly equal. The difference in the hardness and in the ash, probably results from the one specimen having been taken from nearer the crop than the other.

No. 10. *Yellow Springs Gap*, 16 miles from the Susquehanna. Back-bone Vein.—This specimen possessed but little lustre and left a dark red ash.

No. 11. *Yellow Springs Gap.* Vein next north of Central Ridge.—This is a dense, black coal, which cokes. Its ash is pale salmon color.

No. 12. *Rattling Run Gap*, 13 miles from the Susquehanna. Perseverance Vein.—The specimen analyzed was brilliant, with a clear, bright fracture, and burned with a bright flame. Its ash was dark red.

This terminates our series, being the last important coal station where a vein fit for working has been discovered, so far as exploration has gone on.

It would appear from these results, that the bituminous qualities of the coal increase with considerable regularity from Tamaqua to Rattling Run, that from Mauch Chunk being an exception, although its excess of volatile matter may probably be attributed to its containing a larger proportion of water.

Specimens of two other American coals, were examined for comparison with the preceding. These were from the Blossburg or Tioga mines, and from Cumberland, Md.

No. 13. *Tioga.*—The Tioga Coal Field is a detached portion of the eastern extremity of the Great Allegany Coal Basin. The specimen examined was of a medium hardness, and its fractures were sometimes brilliant, sometimes altogether devoid of lustre. Its ash was cream-colored, inclining to grey.

No. 14. *Cumberland, Md.*—This coal is brilliant, with an even fracture, and cream-colored ash, passing to grey.

No. 15. *Black Spring Gap.* Grey Vein.—This remarkable vein, as mentioned by R. C. Taylor, Esq. in his "Report of the Stony Creek Coal Estate," is about seventeen feet thick, containing much fine coal, with a vein near the centre, two or three feet thick, of coal of a greyish color, which has given the name to the whole. The specimen of this included vein, in my possession, closely resembles plumbago in appearance. It burns with little flame, leaving a yellowish red ash.

Table of analyses of coals from Pennsylvania. The numbers refer to those prefixed to the paragraphs.

No.	Locality.	Carbon.	Volatile matter.	Ash.
1.	Lehigh, - - - - -	.870	.073	.057
	Another analysis of the same gave,	.869	.075	.056
2.	Tamaqua, - - - -	.910	.055	.035
3.	Pottsville, - - - -	.884	.068	.048
4.	Pinegrove, - - - -	.859	.072	.069
5.	Black Spring Gap. Fish-back vein,	.840	.065	.095
6.	Black Spring Gap. Peacock vein,	.886	.071	.043
7.	Gold Mine Gap. Peacock vein,	.830	.090	.080
8.	Rausch Gap. Pitch vein, west side,	.771	.109	.120
9.	Rausch Gap. Pitch vein, east side,	.789	.110	.101
10.	Yellow Springs Gap. Back-bone vein,	.775	.110	.115
11.	Yellow Springs Gap. Vein next N. of Central Ridge,	.747	.148	.105
12.	Rattling Run Gap, - - -	.761	.169	.070

No.	Locality.	Carbon.	Volatile matter.	Ash.
13.	Tioga, - - - - -	.725	.175	.100
14.	Cumberland, Md., - - -	.754	.170	.076
15.	Black Spring Gap. Grey vein,	.860	.045	.095

A comparison between the coals of Cumberland, Md., Blossburg, Penn., Dauphin Co., Penn. and South Wales, shows a remarkable similarity of composition as respects volatile matter. The greatest difference, in fact, scarcely exceeds one half of one per cent, as will be seen by the following table.

	Carbon.	Volatile matter.	Ash.
Cumberland, - - - - -	.754	.170	.076
Blossburg, or Tioga, - - -	.725	.175	.100
Dauphin, - - - - -	.761	.169	.070
South Wales, Dowlais, (by Berthier,)	.795	.175	.030

Philadelphia, Dec. 1, 1840.

Art. XIII.—*Proceedings of Scientific Societies.*

I. *American Philosophical Society.*

Nov. 6, 1840.—Professor Bache submitted to the Society a Chart, representing the extraordinary variations of the magnetic declination during the term day, on the 29th of May last, prepared by W. C. Bond, Esq., from the observations at the Magnetic Observatory at Cambridge.

Professor Bache read an extract of a letter from Lieut. Riddell, director of the Magnetic Observatory at Toronto, U. C., which stated that an entire discordance had been found between the curve representing the changes of inclination, on the February magnetic term day, at Toronto, Dublin, Brussels, and Prague, whilst those at the last three named stations agreed very well together. This result, Professor B. stated, confirms the conclusions previously drawn from the observations at short intervals, of Prof. Lloyd and himself, in November last.

Mr. Walker made some observations in relation to the Observatory of the Harvard University, Cambridge, and stated that extensive arrangements had been made, and were in contemplation, for prosecuting magnetic observations and practical astronomy.

Professor Bache made a verbal communication of some recent determinations of the magnetic dip, made by him at Philadelphia and Baltimore.

He reminded the society, that on a former occasion he had submitted a comparison of the observations for magnetic dip at various stations, common to the series of Prof. Loomis, (Am. Philos. Soc. Trans. Vol. VII,

N. S.,) and to that of Prof. Courtenay and himself. The discrepancies at Philadelphia and Baltimore were among the most striking. Having satisfied himself that the dip given by his instrument at the station occupied by Prof. Loomis, near Philadelphia, was sensibly the same as that given by Prof. Loomis, his next step was to ascertain, by observations in a different position from those used in both the sets of observations formerly made, which probably represented more correctly the dip at Philadelphia. The result of two series of observations near the observatory at the Girard College, (at a sufficient distance to be beyond sensible influence from the magnetic instruments,) made with four different needles, was as follows:—

July 21, 1840. No. 1, 71° 51.7′. No. 2, 71° 51.7′. Mean of Lloyd, No. 1 and No. 3, 71° 55.8′.

November 2, 1840. No. 1, 71° 51.2′. No. 2, 71° 51.0′. Mean of Lloyd, No. 1 and No. 3, 71° 57.4′.

Mean, 71° 53.3′.

The needles, termed Lloyd No. 1 and No. 3, are used without reversing the poles; and a correction has been applied from the mean of sixteen comparisons, with the ordinary needles, at different places: as, however, this correction is obtained through Nos. 1 and 2, the results merely add to the number of observations from which the mean is obtained.

Prof. Bache remarked that his former result was thus confirmed.

At Baltimore, the place of observation was in the second square, N. E. of the Washington Monument. The same needles were used.

Aug. 27, 1840. No. 1, 71° 31.7′. No. 2, 71° 39.1′. Mean of Lloyd, No. 1 and No. 3, 71° 32.4′. Mean, 71° 34.4′, differing from the results of both the former series.

Prof. Bache stated, in continuation, that the geological formations at and near Baltimore, rendered it difficult to select an unexceptionable site for magnetic observations there, and was a sufficient explanation of the observed discrepancies. The results, which he had at present obtained, differed about 10′ from the mean of those of Professors Courtenay and Loomis.

Dr. Patterson announced the death of Prof. Charles Bonnycastle, a member of this society, (elected at the last meeting,) which took place on the 31st of October.

Nov. 20.—Dr. Patterson, from the observatory committee, reported, that an ordinance had passed the city councils, authorizing the erection of an astronomical observatory within Rittenhouse square. It was subsequently resolved, that the terms of the ordinance be accepted by the society, and that the observatory committee be instructed to take the necessary measures under the powers given them, for carrying into effect the objects of the ordinance.

Prof. Bache stated, that along with Messrs. Walker, Kendall, Cresson, Frazer, and a pupil of the High School, he had watched for meteors or shooting stars, at the High School, on the nights of Nov. 12-13, and 13–14, and met with the usual negative results of the observations before made in Philadelphia.

Dr. Horner called attention to the noise and shock observed about 9 o'clock on Saturday evening last, (Nov. 14,) which were supposed by some to be those of an earthquake. Judge Hopkinson referred to a statement, that the phenomena were supposed to be produced by the explosion of a near meteor. Mr. Nicklin mentioned facts, which induced him to think there had been a slight shock of an earthquake at the time mentioned. Dr. Chapman and Mr. Cresson attributed the rumbling noise and shock to thunder. Dr. Chapman had noticed a flash of lightning near the horizon, which was followed by thunder. Mr. Cresson had noted an interval of nearly two minutes between the flash of lightning and the clap of thunder.

Prof. Henry described an apparatus for producing a reciprocating motion by the repulsion in the consecutive parts of a conductor, through which a galvanic current is passing; and made some remarks in reference to the electro-magnetic machine invented by him in 1829, and subsequently described by Dr. Ritchie, of London. The machine referred to had been applied recently by Prof. Henry in his experiments.

Prof. Bache communicated an extract of a letter from Prof. Rümker, director of the observatory of Hamburg, which contained the results of his observations of Galle's first comet, and occultations observed in April, May, June, and August, 1840.

Dec. 4.—The committee, consisting of Mr. Richards, Dr. Ludlow, and Mr. G. M. Wharton, on a communication of Prof. Forshey, of Natchez, containing a description of the great mound near Washington, Adams county, Mississippi, reported favorably of the same, and expressed the hope, that the author might be enabled to prosecute farther examinations, "the result of which, with his enlightened commentaries, would furnish a most acceptable addition to the Transactions of the Society."

The mound, described by Professor Forshey, is found about nine miles north-east from the city of Natchez, Mississippi, upon the most elevated portion of that comparatively low and level region. It is approached on all sides by a slope. The elevation of its base above the mean level of the waters of the Mississippi, at Natchez, is estimated at 265 feet, and the greatest height of the mound above the earth, 84 feet. The whole elevation above the waters of the river 348 feet, giving to the spectator a clear horizon of 150 degrees, embracing, in that flat region, a rich and extended prospect.

The mound is an irregular artificial elevation of earth, varying, in its general line, from 40 to 46 feet in height, and encloses an area of about

seven acres inclusive of the ground covered by its base. On the surface of the general mound are erected, at irregular intervals, 15 smaller mounds, one of which is 38 feet in height, and the remaining 14 varying from 4 to 12 feet in height. The mound consists of clay, with some admixture of earth, and its sides seem to have been faced with rudely formed brick, made from the adjacent clay. The bricks are found after digging to the depth of some 12 or 15 inches into the embankment. The western front is ascended by two causeways, which are distinctly marked, and are found one at each angle of the mound. At the eastern extremity is another causeway entrance to the enclosure, and near to this entrance, and outside the embankment, may be traced, for some distance, an ancient fosse. The three causeways are of easy ascent, and wide enough for the introduction of burthens. Upon the north and south sides of the great mound, and at points nearly opposite to each other, covered entrances or archways were constructed, but they are now so obstructed as to be difficult of examination. Before the forest was cleared by civilized culture, tradition relates that extensive avenues reached north, south, east, and west, thus affording, from the elevation of the great mound, a most attractive prospect.

The result, of the partial examinations made, shows that portions of the mound were used as places of interment by the Indians. The cranium secured by Prof. Forshey was of the tribe of Flatheads.

Earthen vessels of rude construction, and probably used frequently as receptacles for the remains of those interred, or as mementos at their funeral obsequies, are found. Various objects from the mound have reached the Lyceum at Natchez.

The committee, consisting of Mr. Lea, Dr. Hays, and Mr. Ord, to whom was referred a communication, entitled "remarks on the dental system of the mastodon, with an account of some lower jaws in Mr. Koch's collection, St. Louis, Missouri, where there is a solitary tusk on the right side, by William E. Horner, M. D., professor of anatomy in the University of Pennsylvania," reported in favor of the publication, which was directed accordingly.

Dr. Horner inquires into the mode of formation of the teeth of the mastodon, and compares it with that of the elephant and of man. The teeth of the mastodon are all formed upon one type of configuration, the number of denticules excepted; they therefore, like those of the elephant, do not admit of a division into incisors, cuspidati, and molares, as in some other animals. The teeth are all molars. The lower jaw itself resembles somewhat a human lower jaw cut off in front of the molar teeth, and then joined in the two posterior segments. These teeth invariably succeed each other from behind; the hindmost, as they emerge, pushing the others forward, and out of their places, until the latter all drop out, and a large solitary tooth is finally left on each side of each jaw.

Dr. Horner alludes to the erroneous nature of the early ideas of naturalists on the teeth of the mastodon, and observes that we now know, with some degree of certainty, that the earliest teeth of this animal were not more than an inch and a half square, and that the three immediately succeeding were a gradual and successive enlargement on this and on each other's volume. In the museum of Mr. Koch, at St. Louis, there is a young head, the long diameter of which is 18 or 20 inches, where the fact of four co-existent teeth on each side of each jaw is exhibited. This specimen, with a dozen lower jaws of different ages and sizes, enables us to trace, with some accuracy, the stages of dentition, until it reaches the large and solitary grinder of ten inches in length on each side. Judging from these phases of dentition, Dr. Horner infers that the entire amount of teeth was at least 24; he is disposed, indeed, to think that the number may have been greater than this; perhaps 28, and possibly 32.

Dr. Horner makes some observations on some specimens of lower jaws in Mr. Koch's museum in St. Louis, in which there was a solitary tusk on the right side, and alludes to the embarrassments that their existence occasions in regard to the Tetracaulodon of Godman; whether, for example, we are to consider them merely as abnormous types of that animal, as known mastodons, or as still another species to which, if such, the name Tetracaulodon might be attached. Dr. Horner confesses himself unable to suggest a probable solution of these questions, and states, in connection with them, that Mr. Koch has the lower part of the head of a mastodon of middling size, in which, from the intermaxillary bone, as usual, protrudes a tusk, which measures thirty inches long by four inches in diameter; but the tusk exists only on the left side, there being not even a vestige of alveolus on the right.

It is very far from being certain, Dr. Horner adds, that any example exists of the upper jaw of the Tetracaulodon; the presence of tusks in both jaws at once has therefore to be yet proved.

The committee consisting of Prof. Bache, Dr. Patterson, and Mr. Lukens, to whom was referred the paper, entitled "observations to determine the magnetic intensity at several places in the United States, with some additional observations of the magnetic dip, by Elias Loomis, professor of mathematics and natural philosophy in Western Reserve College," recommended the same for publication in the Society's Transactions, which was ordered accordingly.

The following is an abstract of the results of observations contained in this memoir.

1. *Magnetic Intensity.*—The horizontal intensity was observed by an apparatus similar to the one used by Prof. Hansteen. Three small needles furnished to the author by Prof. Renwick, and made under the direction, respectively, of Professor Hansteen, Major Sabine, and Prof. Henry, were employed. The commencing semi-arc of vibration was, in every

case, 30°, and each series included 320 oscillations, the instant of the completion of every tenth vibration being noted. No correction, therefore, is applied for the arc of vibration. The times were observed at Dorchester, Princeton, and Philadelphia, by a chronometer, and at the other stations by a lever watch, which, at Hudson, was compared with the observatory clock before and after the observations. The author remarks, that "at the remaining stations there is a little uncertainty with regard to the time, yet it is thought its influence upon the results will not be great."

The correction for temperature, for each of the needles, was obtained by direct experiment, and gave the following coefficients:—

For the Hansteen needle, .000191; for the Sabine needle, .000328; for the Henry needle, .000116. The results of observation are reduced to a standard temperature of 60° Fah.

The author gives the reasons which induce him to apply no correction for the change of magnetism in the needles. The observations for horizontal intensity were principally made in September and November, 1839.

The stations of observation at different places were the same as formerly described, (Am. Phil. Soc. Trans.) except at Dorchester, which was near Mr. Bond's observatory. The details of the observations are given, and from the mean of those for horizontal intensity, combined with the dips formerly observed, the author gives the total intensities, taking New York as 1.803, according to the determination of Major Sabine, and referring to the unit established by Humboldt, as follows:—

	Horizontal Intensity.	Dip.	Total Intensity.
New York,	.96707	72° 52.2′	1.803
New Haven,	.92364	73 26.7	1.780
Dorchester,	.88182	74 16.0	1.786
Providence,	.89830	73 59.6	1.789
Princeton,	.97414	72 47.1	1.807
Philadelphia,	1.00000	72 07.0	1.788
Hudson,	.97344	72 47.6	1.807

The author remarks that Hudson, Ohio, and New York, thus appear to have sensibly the same magnetic dip and intensity. He concludes this part of his memoir with a comparison of his intensity observations with those of Professors Bache and Courtenay.

2. *Magnetic Dip.*—This section commences with an account of observations of the magnetic dip, made at Hudson, Ohio, in different azimuths, to try the figure of the axles of the dipping needles. The results for needle No. 1 were quite satisfactory, and for needle No. 2, showed a difference in the extremes of 12.7′: upon a review of the whole, the author considers them as justifying confidence in the needles used.

The following determinations of the dip are next given:—

		Latitude.	Longitude.	Date.	Magnetic Dip.
Hudson,	Ohio,	41° 15′ N.	81° 26′ W.	April 15, 1840,	72° 53.2′
Aurora,	"	41 20	81 20	Sept. 8, "	72 55.5
Windham,	"	41 15	81 03	" 8, "	73 03.4
Bazetta,	"	41 20	80 45	" 9, "	72 59.7
Kinsman,	"	41 30	80 34	" 10, "	73 08.1
Hartford,	"	41 19	80 34	" 10, "	72 59.8
Warren,	"	41 16	80 49	" 11, "	73 00.7
Cleveland,	"	41 30	81 42	" 22, "	73 12.0
Bedford,	"	41 24	81 32	" 23, "	72 58.0
Twinsburgh,	"	41 20	81 26	" 23, "	72 51.3
Tallmadge,	"	41 06	81 26	" 28, "	72 50.1
Shalersville,	"	41 15	81 13	Oct. 15, "	72 56.6
Streetsboro',	"	41 15	81 20	" 16, "	72 53.0
Tallmadge,	"	41 06	81 26	" 31, "	72 48.2

Mr. Walker read a communication, entitled "researches concerning the periodical meteors of August and November, by Sears C. Walker," which was referred to a committee.

Prof. Bache brought before the society an instrument for measuring the changes in the vertical components of the force of terrestrial magnetism, which he described as combining the principles of the vertical force instrument of Prof. Lloyd, with that of reflection adopted in the magnetometers of Prof. Gauss, and which had been made for him by Mr. Saxton.

Prof. Bache stated, that having found difficulties in the use, especially by his assistants, of the vertical force instrument invented by Prof. Lloyd, and made for the magnetic observatory at the Girard College, by Robinson, of London, he had applied, in June last, to Mr. Saxton, to construct the instrument now presented to the notice of the society. The details had been matured by conference with Mr. Saxton. The magnetic bar, placed and supported as in the instrument of Prof. Lloyd, carries a mirror upon its axis. The mode of adjusting the position of the centre of gravity of the needle does not differ materially from that adopted in the instrument referred to. The needle is raised off the agate planes by the action of a screw, raising a bar which supports two small cups adapted to receive two projecting pins on the arms of the magnet. This magnetometer is observed from a distance, like those of Prof. Gauss. Prof. Bache explained the mode of adjusting the instrument, and of placing the scale and telescopes.

Prof. Bache called the attention of the society to a diagram representing the changes of magnetic declination, as recorded at the magnetic observatory of Mr. Bond, at Cambridge, and at the Girard College, on the magnetic term day of May, 1840, and showing that the changes attending the aurora are not peculiar to one locality, but that, as observed at different places, they are parts of a great magnetic disturbance.

The two curves thus presented agreed remarkably in all their general features, showing, as a general result, similar motions of the needle at the two places in direction, though not always proportional in amount. They presented remarkable differences in the absolute times at which these movements had taken place at the two stations, the similar movements differing frequently five minutes, (with opposite signs,) and in a few cases as much as ten minutes in time; in other cases being simultaneous. The period at which the needle had attained, suddenly, its greatest deviation from the true meridian, was ten minutes earlier in absolute time at Cambridge, than at Philadelphia.

Dr. Demmé referred to the contents of a circular letter from Germany, in which it was stated, that a number of gentlemen of Stuttgart had united, under the name "Societas Bibliophilorum Stuttgartiæ," to publish historical and antiquarian works, which are either out of print, or have never been printed.

The society at Stuttgart will begin to publish as soon as they have procured five hundred subscribers. The subscription is one pound sterling, for which the subscriber will receive one copy; and no more copies will be printed than are subscribed for.

Dec. 18.—The committee, consisting of Dr. Patterson, Prof. Bache, and Mr. Lukens, to whom was referred the communication of Prof. Henry, entitled "Contributions to electricity, No. IV., on electro-dynamic induction," reported in favor of publication, which was directed accordingly.*

The committee, consisting of Mr. Nuttall, Mr. Lea, and Dr. Coates, to whom was referred a communication by Miss Margaretta H. Morris, on the Cecidomyia Destructor or Hessian Fly, reported in favor of publication, which was ordered accordingly.

The committee express the opinion, that should the observations of Miss Morris be ultimately proved correct, they will eventuate in considerable benefit to the agricultural community, and, through it, to the public. Miss Morris believes she has established, that the ovum of this destructive insect is deposited by the parent in the seed of the wheat, and not, as previously supposed, in the stalk or culm. She has watched the progress of the animal since June, 1836, and has satisfied herself that she has frequently seen the larva within the seed. She has also detected the larva, at various stages of its progress, from the seed to between the body of the stalk and the sheath of the leaves. In the latter situation it passes into the pupa or "flaxseed state." According to the observations of Miss Morris, the recently hatched larva penetrates to the centre of the straw, where it may be found of a pale greenish-white semi-transparent appearance, in form somewhat resembling a silk-worm. From one to six of these have

* We omit the abstract of this paper, as it will appear in full in this Journal.

been found at various heights from the seed to the third joint: they would seem to enter the pupa state about the beginning of June.

This fly was not observed by Miss Morris to inhabit any other plant than wheat.

To prevent the ravages of this destroyer of the grain, it will be proper to obtain fresh seed from localities in which the fly has not made its appearance. By this means the crop of the following year will be uninjured; but in order to avoid the introduction of straggling insects of the kind from adjacent fields, it is requisite that a whole neighborhood should persevere in this precaution for two or more years in succession. This result was obtained, in part, in the course of trials made by Mr. Kirk, of Bucks county, Pa., with some seed-wheat from the Mediterranean, in and since the year 1837. His first crop was free from the fly, but it was gradually introduced from adjacent fields; and in the present year the mischief has been considerable. As Miss Morris states that the fly has never made its appearance in Susquehanna and Bradford counties, seed-wheat, free from the fly, might be obtained from these, and probably from other localities.

The committee recommend that the conclusion of Miss Morris "may be subjected to the only efficient test—repeated observations and effective trials of the precaution she advises."

The committee, consisting of Prof. Rogers, Dr. Bache, and Mr. Booth, on a communication, entitled, "on the perchlorate of ethule or perchloric ether, by Clark Hare and Martin H. Boyé," reported in favor of publication, which was ordered accordingly.

In the above paper, the mode of obtaining the perchloric ether, by subjecting a mixture of sulphovinate of baryta and perchlorate of baryta to distillation, is first described. The authors next detail the precautions to be attended to in preparing and experimenting upon this highly explosive compound. They afterwards describe the appearance and properties of the substance which ranks in that class of organic salts, denominated *ethers*. It is a colorless, transparent liquid, heavier than water, and soluble in alcohol, from which it may be precipitated again, by the addition of water. An alcoholic solution of the hydrate of potassa has the power of decomposing it, forming perchlorate of potassa and alcohol. The most characteristic property of the compound is its tendency to explode from the slightest causes.

Dr. Patterson called the attention of the society to the subject of the evolution of electricity from steam, mentioned at the last meeting, and stated that the experiments made lately in England had been successfully repeated by Mr. Peale, Mr. Saxton, and himself, at the United States' mint.

Dr. Patterson said, that their first attempts were to collect electricity from the steam as it issued from a gauge-cock, near the surface of the

water, in the boiler; but in this case the steam was always accompanied by a spray of water, and the experiments failed. They also failed when the steam was of a low temperature, as it was then condensed immediately upon leaving the boiler, so as to form a cloud of vesicular vapor. In both these cases, the electricity, if evolved at all, would be led back to the boiler—the spray and the vesicular vapor being, as is well known, electrical conductors.

When, on the other hand, high steam was drawn off from a stop-cock far removed from the water in the boiler, it was observed to issue, for some distance, in the form of a transparent gaseous vapor, and, in this case, any insulated body on which it was condensed was always found to be charged with electricity. Thus, if the experimenter stood on an insulating stool, or even on a box or ladder of dry wood, and held an iron ladle, or any other conductor, in the issuing steam, the conductor and the operator became so fully charged with electricity, that thick sparks of a half, three-quarters, and in some instances a whole inch in length, were drawn off; the Leyden jar charged; the shock given to several persons holding hands, &c. The electricity thus produced was found to be always positive.

Dr. P. said, that one of the most important conclusions to which the experiments had led, was, that true gaseous steam is a non-conductor of electricity. If it had not been so, the apparatus would not have been insulated, and the electricity excited would have been carried back to the metallic boiler, and thence to the earth.

Dr. P. thought it most probable that the electricity, in these experiments, was evolved by the condensation of the steam—the phenomenon being analogous to the evolution of latent heat by the same condensation. He remarked, that as the steam within the boiler was surrounded by conductors, it could not be supposed to contain free electricity, and that on leaving the boiler, the only sources to which the electricity could be ascribed, seemed to be the condensation of the steam, the oxidation of the iron against which it impinges, or the friction of the steam against the air as it rushes through it.

To show that oxidation was not the source of the electricity, the experimenters caused the steam to strike upon a large bar of fine gold, (400 oz. in weight,) and the generation of electricity was as abundant as when they employed an oxidizable metal. The electricity was also evolved by the insulated operator simply holding his hand in the steam as it issued; in which case the steam was condensed upon the hand, and the whole person became charged. Dr. P. stated, that this was, in fact, the experiment accidentally made near New Castle, in England, and which has attracted so much attention.

To show that the electricity was not caused by the rushing of the vapor through the air, Dr. P. said that an apparatus was made, consisting

of a pipe connected with the stop-cock on the boiler, a portion of about ten inches in length, near the upper end, being of glass, to produce insulation, and the remainder of lead, wound into a helix, like the worm of a still. This helix was immersed in a bucket of water and snow. When the steam was admitted, it became entirely condensed within the pipe, so that there was no rush through the air; yet the production of electricity was as abundant as with the former arrangements.

Dr. P. took notice of experiments made, half a century ago, by Volta and Saussure, and afterwards by Cavallo, which proved, to their satisfaction, that electricity was evolved during evaporation and condensation, but which have since been called in question by Pouillet and others, who assert that a mere change of state, not accompanied by chemical change, never gives rise to electricity. He considered the experiments, now made on a large scale, as favoring, if not confirming, the first opinions entertained on this subject.

Dr. P. referred to the satisfactory manner in which these new experiments seem to explain the sources of electricity in the thunder storm, and in volcanic eruptions.

He then related an experiment in which an insulated iron ball, and afterwards a bar of gold, was heated, and a small stream of water poured on it, so as to be formed into steam at its surface. The first experiments seemed to show that the metal was charged with negative electricity, but subsequent trials threw doubts upon this conclusion.

Dr. P. also described experiments made to determine whether electricity was given off during the solidification of liquids,—the substances used being melted lead, silver, and gold. In every case, however, the gold-leaf electroscope failed to exhibit the presence of any electricity.

Prof. Henry stated that he had not seen the sparks from steam; but that he had obtained feeble electricity from a small ball, partly filled with water, and heated by a lamp. He agreed with Dr. Patterson in the opinion, that the source of the electricity was the change of state, but from water to vapor. There was, however, some doubt on the subject; Pouillet had denied the evolution of electricity from the evaporation of pure water. The facts were interesting, particularly on account of the great intensity of the electricity. The results, obtained by the philosophers, which had been mentioned, indicated electricity of very feeble tension, which could only be observed by the most delicate instruments, but here the sparks were an inch in length. If the vaporization of the water were shown to be the source of the electricity, Prof. Henry thought that the phenomena might be readily explained by the beautiful theory of Becquerel, in regard to the production of the great intensity of the electricity in the thunder cloud. According to this theory, each particle of the vapor carries up with it into the atmosphere the free electricity, which it receives at the moment of the change of state: this, being diffused

through the whole capacity of the air, is of very feeble intensity, although of great quantity; but the condensation of the vapor into a cloud affords a continuous conductor, and consequently the electricity of all the particles of the interior, according to the well known principles of distribution, rushes to the surface of the cloud, and hence the great intensity of the lightning. According to this hypothesis, the insulated conductor, placed in the steam, would act not only as a collector, but also as a condenser of the free, but feeble electricity of the vapor.

Prof. Henry farther stated, in connection with this subject, that he had been informed by several persons, that they had obtained sparks of electricity from a coal stove during the combustion of anthracite. A case had been stated to him several years ago, which he mentioned to his friend, Professor Bache, who informed him that a similar one had fallen under his own notice, in which, however, Prof. Bache had succeeded in tracing the electricity to the silk shirt of the person who drew the spark. Another case had lately been reported to him by an intelligent gentleman, of a stove burning bituminous coal, on board of a steamboat on the Ohio, which afforded amusement to all the passengers during the voyage, by giving sparks of electricity whenever it was touched.

In connection with the facts that had been stated of the production of electricity from steam, Prof. Henry observed that he was now inclined to believe that electricity may also be evolved during the combustion of coal in a stove. But what, he asked, is the source of electricity in this case? Is it combustion, the evaporation of the moisture, or the friction of the hot air on the interior of the pipe?

Dr. Goddard stated, that in the case of a stove, pretty well insulated, his family had amused themselves with drawing sparks half an inch or three quarters of an inch long; and that similar sparks were obtained from the frame of a looking-glass over an open grate, in the house of Dr. Norris, of this city.

Professor Bache remarked, that in the case referred to by Prof. Henry, in which sparks of electricity were obtained from a stove, he had satisfied himself that these were owing to the experimenter wearing a silken shirt:—an experimenter, not similarly clad, being unsuccessful.

Dr. Hare ascribed the incredulity and the opinions which he had expressed, when this subject was brought before the society by Mr. Peale, at the last meeting, to a misapprehension, on his part, as to the circumstances. He considered that the fact of electricity being developed in the case adduced, was established. He alluded to the almost incredible case of a lady, who, agreeably to evidence mentioned in Silliman's Journal, Vol. xxxiii, gave off sparks of electricity. He stated also the result of an experiment to discover whether electricity was given off during the rapid evaporation of a saline solution. There was no evidence of excitement. The vessel was of glass.

Mr. Lea had frequently observed sparks from a common grate.

In reference to the results of experiments by Dr. Patterson, in which no evidence of the development of electricity was observed in metals, whilst undergoing a change from the liquid to the solid state, Dr. Goddard observed, that in cases of crystallization on the large scale, as of nitre, in the extensive chemical works of Mr. Wetherill, a beautiful flash of electrical light was apparent.

Professor Rogers suggested, that in ordinary combustion there may be a constant development of electricity, and that means may possibly be found to render it apparent by perfect insulation.

Professor Henry stated that Pouillet had found that electricity is developed by the combustion of charcoal, and he offered some suggestions as to the mode of rendering the electricity, given off from a stove, apparent, by insulating it both above and below.

Dr. Emerson thought that the change of state from solid to liquid, and from liquid to solid, might account for various electrical phenomena presented by the animal body. Dr. Hare suggested the difficulty, that the human body is a good conductor; and that without a peculiar organization, analogous to that with which nature has endowed the Torpedo or Gymnotus, it is inconceivable that electrical discharges could arise from vital organization. He believed it was admitted by electricians, that there could be no electrical excitement without the existence of the opposite electricities. Agreeably to the published facts of the case to which he had alluded, the lady was permanently in one state of excitement, generating electricity, as animal heat is generated, and throwing off the excess in sparks.

In the case of the Gymnotus, the intensity, Dr. Hare remarked, is so low that sparks are with difficulty rendered apparent at a kerf made by a knife in tinfoil; of course the sparks alleged to be given by the lady, were vastly more intense. From the Gymnotus, sparks could only be received by forming a circuit with a portion of the organic series situate parallel to the spine. Contact in a transverse direction was not productive of any discharge.

II. *Proceedings of the Boston Society of Natural History. Compiled from the records of the society.*

May 20, 1840.—J. E. Teschemacher, Esq., in the chair.

Dr. Enoch Hale read a letter from Rev. Thomas S. Savage, M. D., a missionary at Cape Palmas, West Africa, accompanying which was a valuable donation of entomological and other specimens. The following is the portion of the letter relating to the specimens.

Mt. Vaughan, near Cape Palmas, West Africa, Jan. 15th, 1840.

Dear Sir.—I send five specimens of the *Calandra palmarum* or palm weavel. This insect inhabits the *Elais Guineënsis*, the palm tree from which the natives obtain their palm oil. It lives upon the juices of the tree, which, as they exist in their natural state, are exceedingly sweet and pleasant. It penetrates the cabbage by its rostrum, and is thus often found in the act of sucking the natural palm wine. I am informed by the Africans that the male is distinguished from the female, by being of a smaller size; the female is provided with a tuft of yellow hair upon the upper edge of the beak and the tibia of the fore leg. The larvæ and the fully developed insect are eaten by the natives, and in either state are considered a delicacy; they are eaten uncooked or roasted, with pepper and salt. They are taken by the aged and impotent for their supposed aphrodisiac powers.

There is also a smaller species of *Calandra*, which is very destructive to the rice; it is probably the *C. granaria* of Europe.

The best and rarest of the Lamellicornes which I have transmitted to you, are three specimens of the *Scarabæus Goliathus* of Lin. and Drury. This species has received the different generic names of *Cetonia*, Fab. and Olivier, *Goliathus*, Lamarck and Duncan, and more recently *Hegemon* from Dr. T. W. Harris, of Harvard University. The larger specimen seems to be the *Cetonia cacicus*, Fab. and Oliv., first described by Voët in 1785, and erroneously supposed to be a native of America. (See Hope's Coleopterist's Manual.) This is positively pronounced by the natives to be a male, of which there can be no doubt, from what is known of the sexual distinctions among the group of Lamellicornes. The two smaller specimens are undoubtedly the females of the larger specimen; they are evidently identical with the insect described by Hope as *C. princeps*, and which on dissection proved to be a female; and uncertain whether it had been previously described, he gave it the above name provisionally. The natives declare very positively that it is the "woman" of the larger specimen. They are both found on the same tree and have the same habits. They are not found immediately on the coast, but some miles back from the sea. They abound in January, February and March, and are easily obtained when the natives cut the forest trees preparatory to planting their rice. Yours, &c. Thos. S. Savage.

Dr. T. W. Harris stated that he regarded the specimen described by Dr. Savage as the *Goliathus*, the most valuable addition which had ever been made to the entomological cabinet; he thought it distinct from the *cacicus*, the latter wanting the spots on the shoulders which existed in the specimen under consideration. He regarded it as an undescribed species.

Dr. J. Wyman, exhibited the cranium and drum of the howling monkey, *Simia seniculus*, Buff., a donation to the cabinet from F. W. Cragin, M. D. of Surinam. The cranium is remarkable for the great obliquity of the face, the facial angle being only 30°. When placed in its natural position, the occipital hole is found to be on a level with the superior part of the orbit, and instead of being situated in the plane of the base of the skull as in most of the other quadrumana, it forms a right angle with it as in the rodentia. The lower jaw is excessively developed both in its body and branches, having a surface almost equal to that of the cranium. The branches of the lower jaw form two walls of a large cavity, in which is contained the body of the hyoid bone, modified in a most remarkable man-

ner. The body or central portion of the hyoid bone is transformed into a bony box of an ovoidal shape, the parietes being very thin and elastic. Posteriorly this box is provided with a large opening of a quadrangular shape; on each side of this orifice are two articulating surfaces for the cornua of the hyoid bone. The following are the dimensions of the box, antero-posterior diameter, $2\frac{3}{4}$ inches; vertical, $2\frac{1}{2}$ inches; transverse, $2\frac{1}{4}$.

According to the dissections of Cuvier, the right ventricle of the larynx communicates freely with the cavity of the bone; the left ventricle terminating at the bone without entering it, so that the vocal organs were not symmetrical, presenting a remarkable exception to the characters of the organs of animal life. It is to this remarkable modification of the organs of voice, that the howlers are indebted for the power which they possess of making those loud, hoarse and disagreeable sounds which are capable of being heard at the distance of half a league. They are in the habit of congregating in trees at sunrise and sunset or at the approach of a storm, and of uttering prolonged and frightful howls.

July 15th, 1840.—C. K. Dillaway, Esq., in the chair.

Dr. D. H. Storer read descriptions of eleven species of fishes from the western rivers, by Dr. J. P. Kirtland, of Ohio, each description being accompanied by an accurate drawing. The names of the species were as follows; *Ammocetes concolor*, Raf.; *Coregonus albus*, Les.; *Esox reticulatus*, Les.; *Esox estor*, Les.; *Rostra edentata*, Raf.; *Notuus flavus*, Raf.; *Rutilus Storeri*, Kirt.; *Pimelodus nebulosus*, Les.; *Salmo namycush*, Pen.; *Pimephalis promelas*, Raf.; *Labrax* ——.

An elaborate review of Richard's work on the Coniferæ, was read by Geo. B. Emerson, Esq., president of the society.

Dr. J. Wyman, exhibited specimens of wood, pine cones, and acorns, taken from an excavation in Lowell, near the junction of the Concord and Merrimack rivers. They were found buried in sand at the depth of about 25 feet, several feet below the level of the surface of these rivers. Large trunks of pine trees were found in the same locality, also large quantities of leaves arranged in layers or strata. One of the most interesting objects met with in this locality, was the epidermis from the shell of a Unio, this preserving its shape entire, although the shells had disappeared. These cuticular coverings were found in great numbers; but in no instance was the shell found in connection with the epidermis, this portion having probably been decomposed.

J. E. Teschemacher, Esq., made a report on some seeds and plants from New Zealand, which had been forwarded to Thos. A. Greene, Esq. of New Bedford; these plants and seeds were referrible to the following genera, *Ipogon*, *Mongleria*, *Petrophila*, *Leptospermum*, *Melaleuca*, *Verticordia*, *Acacia* and *Trichinium*. The flora of New Zealand is not yet generally known in Europe by botanical description. Dr. Endlicher has

given an excellent description of some of the plants, and Baron Hugel, Robt. Brown, Lindley, and Hooker, of others; many species however remain undescribed.

Aug. 19th, 1840.—Geo. B. Emerson, Esq., President, in the chair.

Dr. D. H. Storer reported on the reptiles presented to the cabinet by Dr. Savage of Western Africa. This collection consisted of thirteen specimens, each a distinct species, and only one of which was previously in the cabinet; they were all referrible to the genera *Monitor*, *Agama*, and *Scincus*, among the Saurians; *Acontias*, *Crotalus*, *Naia* and *Coluber*, among the Ophidians; there was but one Batrachian and that belonging to the genus *Hyla*. Three species of fish accompanied the collection, belonging to the genera *Psettus*, *Julis* and *Scarus*.

Dr. F. A. Eddy exhibited a specimen of the plant known by the name of "slink weed," which is supposed to have the property of inducing abortion. He stated that a meadow in which this plant was common had gone into disuse, from the fact that the cows habitually cast their calves after feeding upon the herbage: this effect was attributed to the presence of this plant. He believed it to be identical with *Lythrum verticillatum*, L.

Dec. 16th, 1840.—Thomas Bulfinch, Esq., in the chair.

Mr. J. E. Teschemacher made a verbal report on some botanical specimens from Arkansas and other western states, presented to the society by Mr. Edward Tuckerman, Jr. He showed that the *Ergrinum Arkansanum* agreed in its botanical characters with *E. Perofskianum* from Erboul, excepting that the leaves in one are more uncinate than in the other. Mr. T. exhibited dried specimens of the leaves of the *Nepenthes distillatoria*, or pitcher plant; this is a diœcious plant, allied to the *Sarracenia* of this country. The cups formed by the leaves are constantly filled with water secreted by glands on their inner surface; also the fruit of the *Calamus rudentum* or rattan. This is one of the Palmaceæ, its fruit a catkin, spathes numerous; ovarium 3 celled; berry one seeded.

Dr. D. H. Storer exhibited a specimen of the *Polyodon foliaceus*, Lacep. This is characterized by the form of the rostrum, which is long and flat, extending some distance beyond the head, which is commonly known by the name of "fadole," the use of which is not well ascertained. It is however seen thrusting it into the mud in obtaining its food.

Dr. A. A. Gould laid on the table the following species of shells from the Altamaha river, in Georgia, presented to the Society by Jas. Hamilton Couper:—*Unio spinosus; U. Shepardianus; U. obesus; U. splendidus; U. Hopetonensis; U. dolabriformis; U. lugubris;*—also the *Anodonta gibbosa* of Say.

Jan. 20th, 1841.—Geo. B. Emerson, Esq., President, in the chair.

The President exhibited the seed vessel of the *Nelumbium luteum* from the Missouri river. The *N. luteum* belongs to the natural order of the Nymphyæaceæ of De Candolle, of which the number of species is small. It is mentioned by Pursh as occurring in ponds in the neighborhood of Philadelphia, where from its isolated situation, he supposed it must have been carried by the Indians. It is mentioned by Prof. Hitchcock as occurring in Haddam, Conn. The seed vessel is of a conical shape, the base being perforated by about twenty orifices opening into as many cells, each containing a single seed resembling an acorn in shape. This is well figured by Bauhin, and is designated by him as the *Faber Egyptiaca.* The *N. luteum* is described by Mr. Nuttall as bearing the largest of American flowers, the magnolia excepted. Dr. F. A. Eddy states that from descriptions given him by others, he had no doubt that this plant existed in Smithfield, R. I.

Dr. J. Wyman exhibited the cranium of the *Stenorhynchus leptonyx* of Blainville, recently presented to the society's cabinet by Dr. J. B. Johnson of New Bedford. This species is well distinguished from all the other Phocidæ, by the remarkable form of its molar teeth, all of them having the crown deeply trifid, so as to form three sharp conical points, the two exterior of which are bent towards the median line, and the central and longest one having its point curved backwards. The cranium of this species was first figured by Sir Everard Home in his Comparative Anatomy, and in the Philos. Transactions, for 1822. It was afterwards more accurately described by Blainville, by whom it received the specific name of *leptonyx;* his description was drawn from another specimen in one of the French museums. The animal to which this cranium belongs is an inhabitant of the southern Pacific seas, and its habits are not known.

Mr. J. E. Teschemacher exhibited the following specimens of minerals lately received from Dr. Monticelli, some of which are entirely new in this country, viz. Gismondine in Thompsonite, regarded by Brooke and acknowledged by Monticelli as synonymous with Phillipsite and Arisite; Christianite which, according to the Berlin mineralogists is synonymous with Fosterite; Humite; Biotine in brilliant white crystals; Monticellite, of which there is no description; Häuyene in dodecahedral crystals; chloride of copper. Mr. Teschemacher had also been informed by Dr. Monticelli, that the sulphurets of zinc and lead had been met with in lava; it was difficult to account for the presence of these substances, inasmuch as they are volatilized by a temperature equal to that of melted lava.

Art. XIV.—*Bibliographical Notices.*

1. *Plantæ Javanicæ Rariores, descriptæ iconibusque illustratæ, quas in Insula Java, annis* 1802–1818, *legit et investigavit* Thomas Horsfield, M. D.: *e siccis descriptiones et characteres plurimarum elaboravit* Joannes I. Bennett; *observationes structuarum et affinitates præsertim respicientes passim adjecit* Robertus Brown. London, fol. Part I, 1838; pp. 104, tab. 1–25.—Part II, 1840; pp. 90, tab. 26–40. This work is filled with profound observations upon various points in systematic and structural botany, by Mr. Brown, and his worthy associate, Mr. Bennett, (the present secretary of the Linnæan society,) who has elaborated the greater portion of the work. In a note annexed to his revision of the *Cyrtandreæ*, which occupies a portion of the second part, Mr. Brown has contributed a series of condensed, but most important remarks upon the structure of the ovarium, placentæ, and stigmata; and has also expressed his dissent from a recent theory respecting the origin of ovula, (advocated by Schleiden, Endlicher, Lindley, &c.) viz. that the ovula do not belong to the transformed leaf or carpel itself, (except, perhaps, in a few cases,) but are borne on the axis, or on processes of the axis united with the carpels; a view which the analogy of ovula with buds would readily suggest. Mr. Brown defends the prevalent theory, in the following brief remarks. "That the placentæ and ovula really belong to the carpel alone, is at least manifest in all cases where stamina are changed into pistilla. To such monstrosities I have long since referred in my earliest observations on the type of the female organ in phenogamous plants, (in *Linn. Soc. Trans. vol.* 12, *p.* 89,) and since more particularly in my paper on *Rafflesia: (ibid, vol.* 13, *p.* 212,) the most remarkable instances alluded to in illustration of this point being *Sempervivum tectorum, Salix oleifolia,* and *Cochlearia armoracia;* in all of which every gradation between the perfect state of the anthera, and its transformation into a complete pistillum, is occasionally found." The third and concluding part of the work is said to be in progress.

2. *Hooker's Icones Plantarum:* Part VII. In former numbers of this Journal we have already directed the attention of American botanists to this excellent work, and mentioned the plan upon which it is conducted. The seventh part, containing 50 plates, (viz. tab. 301 to 350,) includes perhaps fewer North American species than usual. Among them, however, are figures of our three species of the singular genus *Cercocarpus:* and also of five Californian Compositæ, viz: *Actinolepis multicaulis*, DC., *Madaraglossa heterotricha*, DC., *Hartmannia? pungens*, Hook. & Arn., *Monolopia minor*, DC., and *M. major*, DC. Plate 323 represents a species of the genus *Garrya*, from the mountains of Jamaica! "The very remarkable genus to which this plant belongs,

was established by Dr. Lindley in 1834, on a new plant of North California, found by Mr. Douglas, but discovered many years previously by Mr. Menzies, in his voyage with Capt. Vancouver, and existing in several herbaria to which he liberally presented it. It was, therefore, a matter of great astonishment to me, to find the same genus in a plant of Jamaica, to which Dr. M'Fadyen directed my attention about four years ago, and which is here represented. Mexico, however, which may be reckoned an intermediate country, is now known, by the exertions of Mr. Hartweg, to produce three other species, which are described by Mr. Bentham in his excellent *Plantæ Hartwegianæ*. Mr. Skinner has lately sent me a species, in fruit only, from Guatemala." *Hook.*—A portion of the volume is devoted to some interesting plants from Van Dieman's Land, described and figured by Dr. Joseph D. Hooker, the naturalist of the British Scientific Expedition, commanded by Capt. James Ross, now in the Antarctic sea.

3. *The Linnæa;* edited by D. F. L. Von Schlechtendal. (Halle.) Contents of the 4th, 5th, and 6th numbers of the 13th volume; for 1839.

On *Waldsteinia trifolia;* by *Dr. Koch*, of Erlangen. (With a plate.)

On the fountain of Antritz, near Grätz, (Styria,) in relation to its vegetation; by *Prof. Unger*, of Grätz.

On *Saracha* and *Physalis;* by *Prof. Bernhardi.*

Annual Report on the Flora of Hercynia; by *E. Hampe.* (Aug. 1839.)

Remarks on the genus *Grubbia* of Endlicher; by *J. F. Klotzsch.*

Monstrosities in plants; collected by *Dr. Von Schlechtendal.*

Prodromus Monographiæ Lemnacearum, or Conspectus Generum atque Specierum; by *M. J. Schleiden.* [The Lemnaceæ, following De Candolle, are considered as a tribe of Aroideæ; and the genus Lemna is divided into four genera, viz. 1. *Wolffia*, of Horkel; 2. *Lemna*, (L. minor and L. trisulca;) 3. *Telmatophace*, (founded on L. gibba;) 4. *Spirodela*, (founded on L. polyrhiza.) There is a translation of this memoir, in the *Annals of Natural History*, for December, 1840.]

On two very remarkable instances of vegetable transformation; by Garden-inspector *Weinmann*, of Pawlowsk.

Enumeratio Artemesiarum quas nondum vidit, *W. de Besser.*

De Plantis Mexicanis a Schiede and Car. Ehrenbergio aliisque collectis, &c.; by *Dr. Von Schlechtendal.*

Explanation of the irregularity in Papilionaceous flowers; by *H. Walpers;* (with a plate.)

Animadversiones criticæ in Leguminosas Capenses; by *G. W. Walpers.*

Upon some peculiarities in the growth of arborescent dicotyledonous plants; by *Dr. Becks*, of Münster.

De Galphimiis Mexicanis annotationes; by *F. Th. Bartling.*

On *Pinus pumilio;* by *H. R. Gœppert.*

Remarks on the family *Piperaceæ;* by *Prof. Kunth.* [Apparently a monograph of the order, occupying the whole of the sixth or last number for 1839.]

The Linnæa: contents of parts 1–4, for 1840.

Scholium to Hampe's Prodromus Floræ Hercyniæ; by *Dr. Wallroth.*

De Plantis Mexicanis, &c., continued; by *Dr. Schlechtendal.*

Upon the genus *Tetradiclis;* by *Dr. Bunge;* (with a plate.)

Conferva Lehmanniana, a new species, described by *Dr. Lindenberg;* (with a plate.)

On the structure of the stems of *Isoëtes lacustris;* by *Prof. Mohl;* (with a plate.)

On the *Hausschwarm,* [a kind of Fungus;] by *Schwabe.*

Synopsis Desmidiearum hucusque cognitarum; by *I. Meneghini.*

On the proper place of several families of plants in the natural system. (Anonymous.)

Some new Diatomaceæ of the Eastern coast of Adriatic; by *Hyacinth, Ritter Von Lobarzewski;* (with 3 plates.)

On the movement of the fluid in *Closterium Lunula;* by the same; (with a plate.)

On a collection of plants from Bahia; by *Dr. Schlechtendal.*

Observationes Botanicæ; by the same.

Compositarum novarum decades, ofiert *Dr. G. Walpers.*

Annual Report on the Flora of Hercynia, &c.; by *E. Hampe.*

On the Carices of Thunberg's Flora Capensis; by *Dr. Schlechtendal.*

On a monstrosity of the leaves of *Trifolium repens;* by *Dr. G. Walpers.*

Observations on the variation of the Willows; by *E. Hampe;* with additions by the Editor.

Four new species of *Mammillaria;* by *C. Ehrenberg.*

There are also copious bibliographical and miscellaneous notices appended to each number.

4. *Wikström; Annual Reports to the Royal Swedish Academy of Science, on the Progress of Botany.* The latest volume we have received, is the Annual Report for the year 1837, presented to the Swedish Academy in March, 1838, and published (in the Swedish language,) at Stockholm, in 1839. It forms an octavo volume of 612 pages: it gives a well arranged account of all the botanical works published during the year 1837, so far as they were known to the editor. This work is translated into German, from year to year, with some additions, by Dr. Beilschmied of Breslau, to whom we are indebted for a German edition of the Report for 1821, 1822, and 1824, (Breslau, 1838, forming a volume of 230 pages;) that for 1831, (Breslau, 1834, 200 pages;) and that for 1835, (Breslau, 1838,) which forms a volume of about 420 pages, with copious indexes, &c.

MISCELLANIES.

DOMESTIC AND FOREIGN.

1. ***Exploring Expedition.***—The annexed is the official account of the discoveries made by the exploring squadron in the antarctic regions.

United States Ship Vincennes, March 10, 1840.

Sir,—I have the honor to report that having completed our outfits and observations at Sydney, N. S. W., the exploring squadron under my command, composed of this ship, the Peacock, Porpoise, and Flying Fish, sailed in company on the 24th of December, with my instructions to proceed south as far as practicable, and cruise within the Antarctic Ocean. Copies of the instructions were forwarded to you with my despatch, No. 57.

We continued in company until the first of January, when we parted company with the Flying Fish, and with the Peacock, in a fog, on the third.

I then steered, with the Porpoise in company, for our first rendezvous, Macquain's Island, and from thence to Emerald Island, our second rendezvous, having passed over the supposed locality of the latter in long. 162° 30′ E., lat. 57° 15′ S., without seeing land or meeting with the Peacock or Flying Fish.

On the 10th of January, being in lat. 61° S., we fell in with the first icelands, and continued steering to the southward among many icebergs, which compelled us to change our course frequently in avoiding them.

On the 12th we ran into the bay of field ice in long. 164° 53′ E., and lat. 64° 11′ S., presenting a perfect barrier to our progress further south; a heavy fog ensuing, during which we parted company with the Porpoise, her commander having directions to follow my written instructions in that event.

I had determined to leave each vessel to act independently, believing it would tend to give, if possible, a greater degree of emulation to us all; and being well satisfied that owing to the ice and thick weather, it would be impossible to continue long in company, I deemed it preferable to hazard the event of accident, rather than embarrass our operations.

I therefore submit the details of the proceedings of this ship, as they will, without doubt, nearly coincide with the movements of the other vessels of the squadron, the reports from which will tend to verify our operations.

After an unsuccessful attempt to penetrate through the ice on the 12th of January, we proceeded to the westward, working along with head winds and fogs, and on the 16th we fell in with the Peacock in long. 157° 43′ E., lat. 65° 26′ S.

On the morning of the 19th of January, we saw land to the south and east, with many indications of being in its vicinity, such as penguin, seal, and the discoloration of the water, but the impenetrable barrier of ice prevented our nearer approach to it, and the same day we again saw the Peacock to the south and west. We were in long. 104° 27′ E., and lat. 66° 20′ S.

On the 22d we fell in with large clusters and bodies of ice, and innumerable ice islands, and until the 25th were in a large bay formed by ice, examining the different points in hopes of effecting an entrance to the south, but were disappointed. We here reached the lat. 67° 4′, in long. 147° 30′ E., being the farthest south we penetrated. Appearances of distant land were seen in the eastward and westward, but all points except the one we entered, presented an impenetrable barrier. We here filled up our water tanks with ice taken from an iceberg alongside the ship.

We made our magnetic observations on the ice. The dipping needles gave 87° 30′ for the dip, and our azimuth compass was so sluggish on the ice, that on being agitated, and bearing taken again, it gave nearly three points difference; the variation being 12° 35′ E. A few days afterwards, about one hundred miles further to the west, we had no variation, and thence it rapidly increased in westerly variation, from which I am of opinion that when in the ice bay we could not have been very far from the south magnetic pole. This bay I named Disappointment Bay, as it seemed to put an end to all our hopes of further progress south.

On the 27th we fell in with the Porpoise, in long. 142° 20′ E., and lat. 65° 54′ S., and parted company shortly afterwards.

On the 28th, at noon, after thirteen repulses, we reached long. 140° 30′ E., and lat. 66° 33′ S., where we again discovered land bearing south, having run over forty miles, thickly studded with icebergs. The same evening we had a heavy gale from the southeast, with snow, hail, and thick weather, which rendered our situation very dangerous, and compelled us to retrace our steps by the route which we had entered. During this gale we were unable to see the distance of a fourth of a mile, constantly passing near icebergs which surrounded us, and rendering it necessary to keep all hands on deck. On the morning of the 30th the gale abated, and we returned by the same route to reach the land, when the dangers we encountered among the ice the preceding night, and our providential escape, were evident to all.

We ran towards the land about fifty miles, when we reached a small bay pointed by high ice cliffs and black volcano rocks, with about sixty miles of coast in sight, extending to a great distance towards the southward, in high mountainous land.

The breeze freshened to a strong gale, which prevented our landing, and compelled us to run out after sounding in thirty fathoms water; and

within two hours afterwards the ship was again reduced to her storm sails, with a heavy gale from the southward, with snow, sleet, and a heavy sea, continuing thirty-six hours, and if possible more dangerous than that of the 28th and 29th, owing to the large number of ice islands around us; after which I received reports from the medical officers, representing the exhausted state of the crew and condition of the ship, of which the following are extracts:

The medical officer on duty, reported, under date of the 31st January, that "the number on the sick list this morning is fifteen; most of these cases are consequent upon the extreme hardship and exposure they have undergone during the last gales of wind, when the ship has been surrounded with ice. The number is not large, but it is necessary to state that the general health of the crew is, in our opinion, decidedly affected, and that under ordinary circumstances the list would be very much increased, while the men, under the present exigencies, actuated by a laudable desire to do their duty to the last, refrain from presenting themselves as applicants for the list.

"Under these circumstances we feel ourselves obliged to report, in our opinion, a few days more of such exposure as they have already undergone, would reduce the number of the crew, by sickness, to such an extent as to hazard the safety of the ship and the lives of all on board."

After which, the surgeon, being restored to duty, reported to me as follows:

"I respectfully report that, in my opinion, the health of the crew is materially affected by the severe fatigue, want of sleep, and exposure to the weather, to which they have lately been subjected; that a continuance of these hardships, even for a very short period, will entirely disqualify a great number of men for their duty, and that the necessary attention to the health of the crew and their future efficiency and usefulness, demands the immediate return of the ship to a milder climate."

Deeming it my duty, however, to persevere, I decided to continue, and steered again for the land, which we had named the Antarctic Continent.

We reached it on the 2nd of February, about sixty miles to the westward of the point first visited, where we found the coast lined with solid, perpendicular ice cliffs, preventing the possibility of landing, and the same mountains trending to the westward. From thence we proceeded to the westward along the ice barrier, which appeared to make from the land, until the third, when we again encountered a severe gale from the southeast, with thick weather and snow until the 7th of February, when it cleared up sufficiently to allow us to see our way clear, and we again approached the perpendicular barrier of ice, similar to that which we had previously seen as attached to the land; the same land being in sight at a great distance. We stood along the barrier, about seventy miles to the westward, when it suddenly trended to the southward, and our further pro-

gress south was arrested by a solid barrier or field of ice. After an unsuccessful examination for twenty-four hours in all directions, we continued to the westward along the barrier, as usual, surrounded by ice islands.

On the 8th and 10th (being on the 8th in longitude 127° 7′ east, latitude 65° 3′ south,) we had similar appearances of distant mountains, but the compact barrier extending from east to west by south, prevented a nearer approach.

On the night of the 9th February, being the first clear night for some time, we witnessed the aurora australis.

We continued on the 10th and 11th westward, with southeast winds, and fine weather, close along the barrier, which was more compact, with immense islands of ice enclosed within the field ice.

On the 12th we again saw the distant mountains, but were unable to effect a nearer approach, being in long. 112° 16′ E., lat. 64° 57′ S., and I was again compelled to go on to the westward.

The ice barrier trending more to the southward, induced me to hope that we should again succeed in approaching nearer the supposed line of coast. On the 13th, at noon, we had reached long. 107° 5′, lat. 65° 11′ S., with tolerably clear sea before us, and the land plainly in sight. I continued pushing through the ice until we were stopped by the fixed barrier about fifteen miles from the shore, and with little or no prospect of effecting a landing.

I hauled off for the short night, and the next morning made another attempt at a different point, but was equally unsuccessful, being able to approach only three or four miles nearer, as it appeared perfectly impenetrable. Near us were several icebergs, colored and stained with earth, on one of which we landed, and obtained numerous specimens of sandstone, quartz conglomerate and sand, some weighing an hundred pounds. This, I am well satisfied, gave us more specimens than could have been obtained from the land itself, as we should no doubt have found it covered with ice and snow one hundred or more feet in thickness. We obtained a supply of fresh water from a pond in the centre of the same island. Our position was long. 106° 40′ E., lat. 65° 57′ S., and upwards of seventy miles of coast in sight, trending the same as that we had previously seen.

Although I had now reached the position where our examinations were to terminate by my instructions to the squadron, I concluded to proceed to the westward along the barrier, which continued to be much discolored by earth, and specimens of rock, &c. were obtained from an ice island. A sea leopard was seen on the ice, but the boats sent did not succeed in taking him.

On the 17th February, in long. 97° 30′ E., lat. 64° S., land was again seen at a great distance towards the southwest. We now found ourselves

closely embayed, and unable to proceed in a westerly direction; the ice barrier trending around to the northward and eastward, compelled us to retrace our steps. We had entered a deep gulf on its southern side, and it required four days beating along its northern shore to get out of it. During this time our position was critical, the weather changeable, and little room in case of bad weather. It fortunately held up until we found ourselves again with a clear sea to the northward.

The ice barrier had now trended to about sixty-two degrees of latitude; the wind having set in from the westward with dark weather, and little prospect of seeing the land or making much progress to the westward prior to the 1st of March, thereby losing time which might be spent to advantage for our whaling interests at New Zealand, I determined to proceed to the north on the evening of the 21st.

There was a brilliant appearance of the aurora australis on the 17th February, in lon. 97° 39′ E., lat. 64° S.; also on the 22d Feb. in 103° 30′ E., lat. 58° 10′ S.; on the 25th Feb. in 117° 31′ E., lat. 53° S.; and on the 1st March, in lon. 147° E., lat. 49° 30 S.

The result stated in this report leads me to the following conclusions:—

1st. From our discoveries of the land through forty degrees of longitude, and the observations made during this interesting cruise, with the similarity of formation and position of the ice during our close examination of it, I consider there can scarcely be doubt of the existence of the Antarctic continent, extending the whole distance of seventy degrees from east to west.

2d. That different points of the land are at times free from the ice barrier.

3d. That they are frequented by seal, many of which were seen, and offer to our enterprising countrymen engaged in those pursuits, a field of large extent for their future operations.

4th. That the large number of whales, of different species, seen, and the quantity of food for them, would designate this coast as a place of great resort for them. The fin-backed whale seemed to predominate.

We proceeded on our cruise to the northward and eastward with strong gales, until we reached the latitude of certain islands laid down on the charts as the Royal Company's Islands, about six degrees to the westward of their supposed locality; I then stood on their parallel and passed over their supposed site, but we saw nothing of them, or any indication of land in the vicinity. I feel confident, as far as respects their existence in or near the longitude or parallel assigned them, to assert that they do not exist.

The last ice island was seen in latitude 51° south. A few specimens of natural history were obtained and preserved during the cruise.

As I conceive it would be unbecoming in me to speak of our arduous services, the report and accompanying chart of our cruise must speak for us; but I cannot close this report without bringing to your notice the

high estimation in which I hold the conduct of the officers, seamen, and marines, during this antarctic cruise, the manner and spirit, together with the coolness and alacrity with which they have met the dangers and performed their duties. I trust that they will receive from the government some gratifying notice of it. All I can say in their favor would fall far short of what they deserve.

I shall ever bear testimony that they have proved themselves worthy of the high character borne by our countrymen, and the navy to which they belong.

I have the honor to be, sir, most respectfully your obedient servant,

CHARLES WILKES,

Com'g Exploring Expedition of the United States.

To the Hon. James K. Paulding, Sec'y of the Navy, Washington City.

Note.—After cruising among the isles of Oceanica, the squadron arrived at the Sandwich isles, October, 1840, having sustained the melancholy loss of Lieut. J. A. Underwood, and midshipman Wilkes Henry, who were murdered July 25, by the natives at Malao, one of the Fejee isles.

2. *Theory of Water Spouts and Tornadoes.*—A few weeks since a large kettle of water, which having been used for washing, was covered with a thick smooth scum of curdled soap, was hanging over the kitchen fire, and though there was no ebullition, a dense volume of steam was rising from it, and with a rapid whirling motion ascending the chimney. My attention was drawn to it from the fact, that the movement of the steam was affording additional proof of the general course of all atmospheric currents from right to left, according to the theory of Mr. Redfield, a theory, of which thus far, we have frequently noticed the verification. The steam whirl formed immediately over the surface of the kettle, and made a column some two or three inches in diameter, for about eighteen inches in length, when it disappeared behind the mantle of the chimney. In the centre of the whirling column of steam, which rotated with astonishing rapidity, a clear space could be seen, distinctly marked by a difference in color, showing that the pillar was a tube. As in obedience to the different currents of air in the room, the column changed its position over the surface of the kettle, we observed the movement was accompanied at times with a curious agitation, which at first was supposed to be mere ebullition; but from its being always under the centre of the column, being most violent where the whirl approached nearest its surface, and shifting position with it, was soon perceived to be owing to that.

The appearance was as if a man's hand was moved under the surface, at times protruding his forefinger upwards, and lifting the scum, or rather forcing the finger through it to its full extent. It occurred to us at once as a fine illustration of the commencement of a water spout, and we continued our examination for some time until the general motion of the sur-

face by boiling prevented any very marked action of the whirl. As the rising fluid evidently ascended the clear space in the centre of the cone or column, it was certain that the column was hollow, and that within the whirl there was a diminished atmospheric pressure. During the times that the water mounted the highest, (which was between four and five inches,) there was a violent agitation of the surface in the immediate vicinity of, or beneath the base of the rotating column, and a careful examination showed that small pieces of the foam were occasionally wrested from the upper part of the rising water and instantly disappeared. It could not be seen that there was any distinct rotation to the elevated water, which swayed and bent with the column of steam.

It appeared to us that from this incident, simple and trifling as it may appear in itself, some valuable inferences may be drawn. The origin of water spouts, in connection with whirlwinds, and the laws that regulate the ascent of water, were well exhibited. That water should ascend to the height it evidently does in water spouts at sea, by atmospheric pressure alone, is not to be supposed; but it is atmospheric pressure that forces the water into the hollow at the base of the cone, and places it in a position to be first acted upon and then lifted by the whirling air. When once the upward current is established, there seems to be no difficulty in continuing it; and, as the water thus lifted must return to the earth by being thrown without the upper circumference of the whirl, or when the column is suddenly separated, by pouring downward with the same volume with which it was rising, it accounts for the deluges of water that at times accompany water spouts.

The action or ascent of the water within the tube also showed that the atmospheric pressure was greatly lessened or removed in the interior of the whirl, and thus explained satisfactorily many of the phenomena that accompany tornadoes or whirlwinds. Thus it has always been found in violent tornadoes, that the windows or gables of buildings that were near the centre of the line of the whirlwind, are almost invariably burst outwards, and frequently directly in the face of the advancing storm. This was particularly noticed at the destruction of Natchez, and at Shelbyville, and cannot be well accounted for in any other way than by the violent expansion of the air within the buildings, when the outer pressure is suddenly taken off.

In many storms or tornadoes, the thunder does not appear in distinct explosions, nor the lightning in separate flashes. On the contrary, there is a continued blaze of fire in the cloud and the roll of thunder is incessant. In such cases, effects are observed which indicate in the line of the storm the continued action of electric energy, and give reason to suppose that the ascending column produced by the whirl forms a perfect conductor, along which the electric fluid descends continuously and not in successive masses. Thus in most tornadoes the trees within their

range that are not torn up, have their leaves scorched and withered as if a fire had passed over them, and iron substances, such as farming implements, always exhibit unequivocal evidence of having been submitted to electrical action. This was particularly noticed in the tornado near New Haven. That such is the case, the fact, that in such tornadoes occurring in the night the central part of the whirl appears like a pillar of fire or heated iron, is conclusive evidence. Of such appearance the tornado at Shelbyville, and the one described by Arago near Paris, are examples. If a stream of smoke from a chimney, or a column of heated air from grain or hay in a barn are such conductors, as experience shows them to be, there can be no doubt that such a column as is formed in a whirlwind, reaching from the earth to the heavens, would form one still more efficient. W. G.

Otsco, N. Y. Jan. 1841.

3. *Notice of a new variety of Beryl,* recently discovered at Haddam, Conn.; by* JOHN JOHNSTON, A. M., *Professor of Natural Science in the Wesleyan University, Middletown, Conn.; Corresponding Member of the New York Lyceum of Natural History.*—Read before the Lyceum, Jan. 11th, 1841.—This mineral which I propose to notice, evidently belongs to the species beryl, with which it closely corresponds in its natural properties; but differs from it in color and in the great perfection and exquisite finish of the crystals, as well as some other peculiarities to be hereafter noticed.

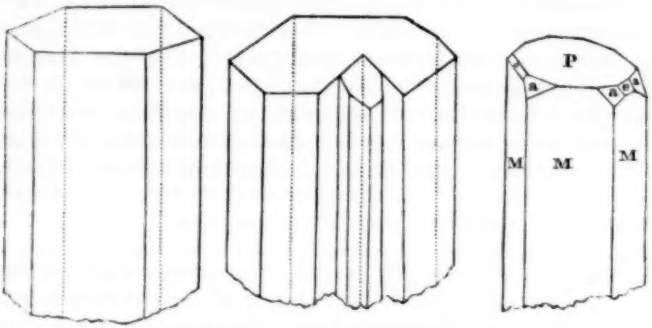
The color is mountain green, or perhaps better, milky mountain green, all the crystals possessing a peculiarity which is best described by this word. One terminal plane in nearly all the crystals is perfect, and, like the other faces, possesses an exquisite polish. In most of the crystals the peculiar milkiness ceases near the terminal face, which presents the appearance, as an individual remarked, of having been veneered with green glass. Sometimes this transparent portion is a quarter of an inch thick, but usually it is about the thickness of window glass, which it much resembles. The hardness is about 7.5, which is the same as that of common beryl. The specific gravity of four specimens was found to be as follows, viz. 2.716, 2.717, 2.719, 2.716; that of the common beryl is from 2.678 to 2.732.

On the lateral faces of many of the crystals are numerous rhombic figures, produced by crystallization, like the faces of rhombohedra, which may be supposed to be contained within the crystals, but having their faces a little elevated above those of the former. This appearance, which it is believed has not been observed in the common beryl or the emerald, seems to indicate that the rhombohedron is the primary form of this spe-

* See Vol. XXXVIII, p. 68, of this Journal.

cies, and not the hexagonal prism, as has generally been supposed. A few specimens have been found striated longitudinally like ordinary crystals of the species.

The accompanying figures represent three of the best specimens I have obtained of the natural size.



P : a = 134° 36′
P : e = 149 40
M : a = 127 44

A single attempt at analysis has been made, but without obtaining results in any respect peculiar; a more critical analysis is desirable.

The first specimens of this mineral were discovered in the winter of 1837–8. They occur in a vein of feldspar which traverses one of the gneiss quarries on the east side of the Connecticut river, nearly opposite the Congregational meeting house* at Old Haddam.

Specimens continued to be found, though not very plentifully, for two years or more, but none as I can learn have been found for a year past; and the best ones are now held very high by the workmen of the quarries.

Wesleyan University, May, 1840.

I cannot learn that any more specimens have been discovered since the above date.—Jan. 7, 1841.

4. *Meteorology.*—We invite the attention of our readers and correspondents to a project for generalizing the history of meteoric phenomena, and invite their communications, in compliance with the request of our correspondent, Mons. Morin, engineer of bridges and causeways, and correspondent of the meteorological society of London, who dates from Veroul, 220 miles N. E. of Paris.

As you have been so kind as to view with a favorable eye my meteorological undertaking, I have the honor to solicit you to engage the rea-

* Within six or eight rods of this house is the chrysoberyl locality, at which several other minerals are also found, as the columbite, automolite, zircon, &c.

ders of your scientific Journal to give the history of seasons in America, from the year 1600 to the present year, and to communicate to you the results of their researches.

I have these observations in the United States since the year 1793 to the end of 1837, and some in 1739. I have very few from 1758 to 1600, and few from 1758 to 1793. In the mean time, the recitals of epidemics, of voyages and travels, the history and statistics of agriculture, of the sciences, and of chronology, either printed or in manuscript, may supply the place of regular observations. It will promote these researches, to furnish the means of making them, by pointing out the works where the information may be found.

If I can compile this history for the entire surface of the globe, I think, that by means of tables announced in my eighth memoir, we shall be able to predict the seasons for future times. For those years or points of time where information is deficient, I think that the deficiencies can be theoretically supplied.

Will you, then, I beseech you, by means of your Journal, engage your readers to occupy themselves with this history of the seasons in America, and to communicate to that work the result of their labors? I observe in No. 57, p. 182, (Vol. xxviii,) of your Journal, that New Haven possesses meteorological observations for 70* years.

Can you procure for me the thermometrical mean for December, for each of those years? I intend to prepare the history of the seasons back as far as 1150; as far as regards America, I think it may be carried back to the year 1500.

5. *Royal Society of Northern Antiquaries.*—The labors of this enterprising and distinguished society merit an extended statement at our hands, but owing to the pressure of other contributions, we are unable to give more than a very brief notice.

This society, as is well known, has its seat at Copenhagen, and ranks among its members many eminent and efficient historical investigators of various countries. Its primary object is to bring to light, and to publish with the necessary illustrations, all ancient documents relating to the history and early literature of Scandinavia. It goes farther, and has, with great zeal and ability, prosecuted its inquiries into the history of the Northern adventurers in other countries, especially in America and in the British isles. The society is one of the oldest antiquarian associations in Europe, and has been uncommonly active and successful. As a partial result of its labors, it has already issued more than forty volumes,

*The passage alluded to by M. Morin, mentioned the cold 70 years ago, but we are not aware that the observations have been regularly continued; we believe they are tolerably continuous for the 40 years past.—*Eds.*

replete with historic lore.* Of these the most interesting to us is the *Antiquates Americanæ, sive Scriptores Septentrionales rerum Ante-Columbianarum in America*, (Hafniæ, 4to. 1837, pp. 486.) This consists of ancient Icelandic histories regarding America, composed chiefly of Narratives of Voyages made to this country by the Northmen, in the 10th, 11th, 12th, and 13th centuries; of course long before the time of Columbus. These are illustrated by critical and historical notes, geographical discussions, &c., concerning the voyages, settlements, and migrations of the Northmen, and with especial reference to the monumental vestiges still remaining in America. The famous inscription on the Dighton rock, (Beverly, Mass.,) is interpreted to assert that *Thorfins* (who was chief of the colony which went from Greenland to Vinland A. D. 1007,) *with a company of* 151 *men, took possession of the country.* After the most laborious research, the editors come to the conclusion that *Vinland* lay at the head of Narragansett Bay, in Rhode Island. Whatever opinion on this subject may finally be considered the true one, the volume in question must be esteemed a most valuable contribution to our history.

In addition to its other publications, the society has proposed to issue their Transactions and Researches concerning the earlier history and antiquities of Northern Europe and America, in two simultaneous periodical works, to be entitled *Annals* and *Memoirs*. In the *Annals*, contributions of the above mentioned nature will be received in Danish or Swedish, (and occasionally in Icelandic,) and wherever it may appear desirable, *maps* will be given, and also *Delineations of Antiquities*, and of the *Monuments* of ancient times. The *Memoirs*, which are inseparably connected with the Annals, will comprise similar contributions in English, French, or German, either original or translated. In English, e. g. will be from time to time inserted the result of the continued investigations and researches of the Society's Committees on the *Historical*

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*The following is a list of some of the publications referred to. Fornmanna Sögur, or *the historical Sagas recording events out of Iceland*, in the original Icelandic, or Old-Northern text; complete in 12 vols. 8vo. Price, vellum paper, $33, common paper, $22.

Scripta Historica Islandorum, the same Sagas translated into Latin, with a critical apparatus; 12 vols. 8vo.

Oldnordiske Sagaer, the same translated into Danish; 12 vols. 8vo. Price, common paper, $17.

Færeyinga Saga, or the history of the inhabitants of the Faroe Islands, in Icelandic, the Faroe dialect, and Danish, and with a map of the islands; 8vo. $1.75.

Fornaldar Sögur Nordrlanda, vol. 1-3, being a complete edition, in 8vo., of *the mytho-historical Sagas.*

Krakumal sive *Epicedium Ragnaris Lodbroci*, or Ode on the heroic deeds and death of the Danish king, Ragnar Lodbrok, in England; in Icelandic, Danish, Latin, and French; 8vo. $2.

Nordisk Tidsskrift for Oldkyndighed, *Archæological Transactions;* 3 vols. 8vo. $4.75.

Monuments of Greenland, and *on the Ante-Columbian History of America.* Of the Annals, one number in 8vo. is to be published yearly, beginning with 1836, and of the Memoirs, a similar number every second year, commencing with 1838.

We trust that this important society will continue to be regarded with favor by the American people; and that our literary institutions and public libraries will not fail to furnish themselves with its valuable publications.

6. *Fossil Remains in Lenoir County, N. C.*—Extract of a letter to the editors from JOHN LIMBER, dated Strabane, Lenoir county, N. C., June 10th, 1839.—This location was discovered by Mr. Richard Rouse, the owner of the land, when digging a dike to drain a bog. The location is near the summit level between the Neuse and North East rivers. It is on a branch of the Neuse, three miles from it, and at least one hundred feet above it, and about sixty miles west of Pamlico Sound.

The upper stratum of earth is about three feet in depth, and is the common soil of the region, viz. a fine white sand and vegetable matter. The next stratum is of about the same depth, and is composed almost entirely of *shells*, of a great variety of species; and a still greater variety of sizes. These are cast together in every manner, lying in every position, and shells in shells. Next is a stratum of yellowish clay only a few inches in depth, and containing bones of enormous size. Below this is a stratum of black clay impenetrable by water; depth unknown. This also contains a few bones and in a more perfect state.

On the first of June I visited this location in company with Mr. Rouse, and in two hours we found bones enough for a load to transport home in our arms. Among them was a piece of a rib-bone about two feet in length, which measures three and a half inches in width, and about two and a half in thickness. We also found a tooth of a triangular shape, which is four inches across the base, and about five in length. Mr. Rouse informed me that he had found a part of a tooth, which must have belonged to one four times as large as the one I found: and that he had found a *vertebra* eight inches in diameter. These bones are found in all the strata, but the largest are the lowest. Of the quantity of shells it may not be amiss to say, that there are millions of bushels, and they are beginning to be used for manure.

7. *Removal of Fishes.*—In Dr. Storer's report on the subject of fishes, given at page 378 of the last volume, he remarks, that the only instance with which he was acquainted of the successful removal of a species of fish from one body of water to another in this country, was that of the removal of the *Perca flavescens* from Rockonkoma to Success pond on Long Island, by Dr. Mitchill.

About fifteen years since Mr. Robert Kinyon, then living at the village of Amber on the east shore of the Otisco lake, in Onondaga county, determined to make an effort to introduce into its waters, yellow perch from the Skaneateles, in the waters of which they abound; and pickerel from the cluster of lakes or ponds that constitute the extreme northern sources of the Tioughuioga branch of the Susquehanna river, in some of which this fish is very plentiful. Neither of these fishes had been seen in the Otisco; but suckers, an occasional white fish from the lakes, and the delicious speckled trout abounded in its waters, as well as the smaller fishes common to all our lakes. In the Skaneateles, only three miles distant, were found the perch and the salmon trout, both strangers to the Otisco. A dozen perch of medium size were caught with hooks, put in a barrel of water, and transported from one lake to the other without difficulty. The third year from their removal the Otisco seemed to be filled with them; and I have frequently heard it remarked, that in that and the succeeding year, the perch both for size and numbers exceeded that of any year since in these respects. If we may speak of our own piscatory labors, we may say they were decidedly more successful in those years so far as this fish was concerned, than they have ever been since. A quantity of the pickerel were the same season introduced in the same way, but they have not multiplied; indeed we have never heard of a fish of this kind being taken in the Otisco.

The fine trout that formerly were caught in the lake have gradually become scarce, and are now very rarely taken. This by some has been attributed to the introduction of the perch; but it is believed a more satisfactory cause is to be found in the perseverance and success with which the trout was pursued when entering the inlets or making its beds on the shores in October and November, for the purpose of spawning. Very few that entered the streams escaped, and in this case, the capture of one was frequently the destruction of a thousand.

We have known the common dace and bullpout of this lake, transported some three or four miles to a mill pond, in which they have multiplied to a great extent; the former filling the streams both above and below the pond, while the latter preferred the deep water and muddy bottom of the pond to the clear water of the streams. We imagine there are few if any of our fresh-water fishes, that may not be successfully removed to other locations, should it be found desirable. W. G.

Otisco, N. Y. Jan. 1841.

8. *Stars missing.*—In the volume of Greenwich Astronomical Observations made in 1838, (published in London, 1840, 4to.) the following stars are reported as having been repeatedly sought for, but without success:

A star A.R. 2h. 9m.; N.P.D. 24° 31′, observed with Ramsden's sector, in the Ordnance Survey of England.

A star A.R. 5h. 2m. 51s.; N.P.D. 71° 43′, whose occultation by the moon was observed by Mayer, 1756, September 15. (See Mr. Baily's edition of Catalogue, Mem. Astron. Soc. Vol. iv.)

9. *Ice formed at the bottom of a river.*—In the Journal for April, 1839, page 186, is a letter from Mr. Sheffey on the subject of ice found at the bottom of rivers and seas. The explanation of this perhaps, is, that the rapidity of the current prevents ice forming on the surface; but at the bottom where friction makes the current much less rapid, it becomes possible for the water to turn into ice. If I remember rightly, this is an explanation I heard in Prof. Jameson's Nat. Hist. class, Univ. Edinb. The same reason will apply to seas, where the agitation on the surface prevents freezing; but at the bottom where the water is still, ice is found.

Kingston, U. C., Nov. 5, 1840. T. Stratton.

10. *Depth of the Ocean.*—The sea was recently sounded by lead and line, in lat. 57° south, and long. 85° 7′ west from Paris, by the officers of the French ship Venus, during her voyage of discovery; at a depth of 3470 yards, or 2½ miles, no bottom was found. The weather was very serene, and it is said that the hauling in of the lead occupied sixty sailors more than two hours. In another place in the Pacific Ocean, no bottom was found at the depth of 4140 yards.—*N. Y. Jour. of Com. Nov.* 17, 1840.

11. *Obituary of Ebenezer P. Mason.*—Died at Richmond, Va., on the 26th of December, 1840, Mr. Ebenezer P. Mason, in the 22d year of his age. His last work, the conclusion of an *Introduction to Practical Astronomy*, (8vo. pp. 141,) was finished only three weeks before his death. From the biographical sketch prefixed to this work by Prof. Olmsted, we make the following extracts, in the expectation that an extended memoir will appear in some future number.

"Immediately after completing this treatise, (which he could not be persuaded to leave unfinished,) Mr. Mason yielded to the solicitations of his relatives at Richmond, Va., who had for some time been urging him to hasten to that milder climate, with the hope of preserving, or at least of prolonging, his valuable life. In less than two weeks after he reached his friends, he experienced a sudden prostration, and quietly sunk into the arms of death.

"The present treatise on Practical Astronomy was chiefly written in the spring of 1840, before his health failed. Early the ensuing summer symptoms of consumption began to develop themselves; and hoping to receive benefit from the invigorating climate of Maine, and eager to embrace every opportunity for making astronomical observations, he obtained the post of assistant in the Commission under Prof. Renwick, which ex-

plored the northeastern boundary of the United States during the last autumn. Sustained by a temper remarkably cheerful and resolute, he was able to fulfil the duties of his appointment; but on his return, the latter part of October, it was manifest that his disease had made regular progress and was carrying him to the grave.

"Young Mason was truly a man of genius: and short as was his career as an astronomer, he accomplished enough to inspire in his scientific friends the highest expectations of his future eminence in the exalted study to which he had devoted himself. The peculiar assemblage of faculties requisite to form the great astronomer, is seldom found united in the same individual, comprising as it does so many of the higher attributes of genius,—a *hand* of exquisite delicacy to construct and adjust,—an *eye* endued with extraordinary powers of vision to observe,—an *intellect* the most profound to follow out all the consequences of astronomical discovery; and that unconquerable *enthusiasm* which is regardless of loss of rest, of exposure by night, and even of life itself. These qualities were *severally* possessed by Mr. Mason in an unusual degree; but it was their striking and harmonious *union*, which, from the time I first discovered it, led me to recognize in him the promise of one probably destined to enlarge the boundaries of astronomical science." * * *

"This work will, I think be found, on trial, more peculiarly adapted to the exigencies of young students of practical astronomy, than any similar treatise hitherto published; and I cannot but believe that all who peruse it, will unite with me in deploring the untimely fate of a youth, who has given such signal proofs of his capacity to attain to the highest walks of astronomy."

12. *Supplementary Note to Prof. Adams's Catalogue of the Mollusca of Middlebury, Addison Co., Vt.* (See pp. 271, 273.)

Note to Pupa milium.—"By the kindness of Prof. Bronn, of Heidelberg, Germany, I have just received specimens of *Pupa minutissima, Hartm., Rossm.*, &c. (v. Desh. in Lam. An. sans Vert., Pupa, No. 46,) which are very similar in size and form to *P. milium*, but in other respects widely distinct. Ten specimens weigh .06 gr., or .006 gr. each. The remark of Deshayes is 'cette espèce est certainement l'une des plus petites du genre.'"

Note to Helix striatella, Anth.—"Prof. Bronn has sent me from Stiria, Austria, specimens of this species labelled '*H. ruderata, Studer.*' They do not differ in any respect from American specimens, except that one of them has a tinge of green. Anthony's description was published January, 1840. The description of the European author I have not seen; but as the shells were packed by Prof. Bronn only three months later, there is scarcely a doubt that the name *H. ruderata* has the priority."

Middlebury, February 10, 1841. C. B. A

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of the microfilm user.